GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1992

by

D.M. Batty, L. R. Herbert, and others

United States Geological Survey

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CONVERSION FACTORS

Multiply	by	To obtain
acre-foot	1233.	cubic meter
foot	0.3048	meter
inch	25.4	millimeter
mile	1.609	kilometer

Chemical concentration is given only in metric units-milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as concentrations in parts per million.

DEFINITIONS OF TERMS

Acre-foot (AC-FT, acre-ft)—The quantity of water required to cover one acre to a depth of one foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

Dissolved—Material in a representative water sample which passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Land-surface datum (lsd)—A datum plane that is approximately at land surface at each ground-water observation well.

Milligrams per liter (MG/L, mg/L)—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.

Specific conductance—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25° C. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure or above-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward graph for a period of years represents a period of generally below-average precipitation, which commonly causes and correlates with declining water levels in wells. Likewise, a generally upward graph for a period of years represents a period of above-average precipitation, which commonly causes and correlates with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

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INTRODUCTION

This is the twenty-ninth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, published cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, related changes in precipitation and streamflow, and chemical quality of water. Supplementary data such as maps showing water-level contours are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water development in the State for the calendar year 1991. Water-level fluctuations and selected related data, however, are described for the period from the spring of 1987 to the spring of 1992. Most of the data used in the report were collected by the U.S. Geological Survey in cooperation with the Division of Water Rights and the Division of Water Resources, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were printed by the U.S. Geological Survey, printed by cooperating agencies, or published in conference proceedings during 1991:

Ground-water conditions in Utah, spring of 1991, by L.R. Herbert, J.S. Gates, and others, Utah Division of Water Resources Cooperative Investigations Report No. 31.

Infiltration of unconsumed irrigation water in Utah, by W.C. Brothers and S.A. Thiros, Proceedings of the American Society of Civil Engineers 1991 National Irrigation and Drainage Conference, Honolulu, Hawaii, July 22-26, 1991.

Ground-water resources and simulated effects of withdrawals in the Bountiful area, Utah, by D.W. Clark, Utah Department of Natural Resources Technical Publication No. 95.

Hydrologic reconnaissance of the Sevier Lake area, west-central Utah, by D.E. Wilberg, Utah Department of Natural Resources Technical Publication No. 96.

Hydrology and effects of mining in the Quitchupah and Pines coal-lease tracts, central Utah, by S.A. Thiros and G.E. Cordy, U.S. Geological Survey Water-Resources Investigations Report 90-4084.

Sources, sinks, and effects of selenium at Stewart Lake Waterfowl Management area, Jensen, Utah, by D.W. Stephens, Bruce Waddell, and J.B. Miller, U.S. Geological Survey Water-Resources Investigations Report 91-4034.

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Relatively few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that penetrate consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah withdraw water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated deposits are in large intermountain basins, which have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1991 was about 906,000 acre-feet (table 2), which is about 34,000 acre-feet less than the revised estimate for 1990 and about 134,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). The average annual withdrawal during 1987-91, 869,000 acre-feet, was 183,000 acre-feet more than during the preceding five-year period, 1982-86 (table 2). On the basis of previously unavailable data, values of total withdrawals of water from wells for the Salt Lake Valley for 1988, 1989, and 1990 have been revised. On the basis of this revision, the total withdrawal of water from wells in Utah during 1990 is now estimated to be 940,000 acre-feet. This adjusted total is the largest annual withdrawal of ground water on record since estimating Statewide withdrawals began in 1963, exceeding the previous high in 1977 by 24,000 acre-feet. Withdrawals in 1991 for irrigation, public supply, and domestic and stock use decreased compared with 1990 totals, but withdrawals for industry increased. Withdrawals for irrigation were about 542,000 acre-feet (table 2), a decrease of 25,000 acre-feet from 1990. Withdrawals for public supply were about 196,000 acre-feet, which is 14,000 acre-feet less than the estimate for 1990. Withdrawals for industrial use were about 106,000 acre-feet, which is 11,000 acre-feet more than the adjusted 1990 estimate.

In 8 of the 16 major areas of ground-water development referred to in this report (table 2), ground-water withdrawals decreased from 1990 to 1991. These areas include Curlew, Cache, Salt Lake, Tooele, Utah and Goshen, Juab and Pahvant Valleys and the Beryl-Enterprise area. Withdrawals in the central Sevier Valley, Sevier Desert, central Virgin River area, and "other areas" remained the same in 1991 as in 1990. Withdrawals in 1991 in the other four areas, East Shore, Cedar and Parowan Valleys, and the Milford area, exceeded estimated withdrawals for 1990.

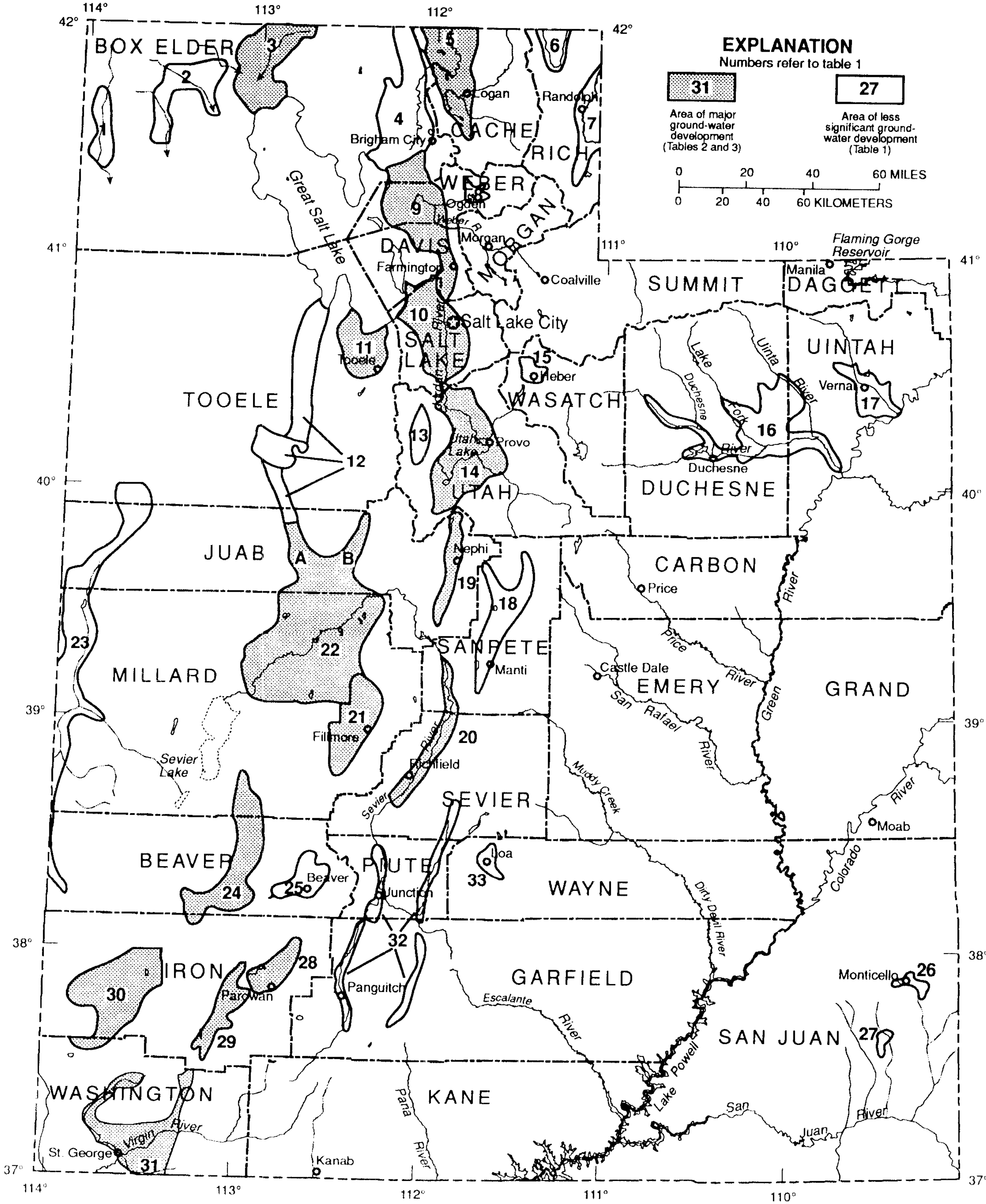


Figure 1.--Areas of ground-water development specifically referred to in this report.

Table 1.—*Areas of ground-water development in Utah specifically referred to in this report*

Number in figure 1	Area	Principal type of water-bearing rocks
1	Grouse Creek Valley	Unconsolidated
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Malad-lower Bear River valley	Unconsolidated
5	Cache Valley	Do.
6	Bear Lake valley	Do.
7	Upper Bear River valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Tooele Valley	Do.
12	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
13	Cedar Valley, Utah County	Do.
14	Utah and Goshen Valleys	Do.
15	Heber Valley	Do.
16	Duchesne River area	Unconsolidated and consolidated
17	Vernal area	Do.
18	Sanpete Valley	Do.
19	Juab Valley	Unconsolidated
20	Central Sevier Valley	Do.
21	Pahvant Valley	Do.
22	Sevier Desert	Do.
23	Snake Valley	Do.
24	Milford area	Do.
25	Beaver Valley	Do.
26	Monticello area	Consolidated
27	Blanding area	Do.
28	Parowan Valley	Unconsolidated and consolidated
29	Cedar Valley, Iron County	Unconsolidated
30	Beryl-Enterprise area	Do.
31	Central Virgin River area	Unconsolidated and consolidated
32	Upper Sevier Valleys	Unconsolidated
33	Upper Fremont River Valley	Unconsolidated and consolidated

Table 2.—*Number of wells constructed and withdrawal of water from wells in Utah*

Number of wells constructed in 1991—Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes test wells and replacement wells.
Diameter of 12 inches or more—Constructed for irrigation, industry, or public supply.
Estimated withdrawals from wells—

1990 total: From Herbert and others (1991, table 2), as revised.

1982-86 and 1987-91 average annual: Calculated from previous reports of this series and also include some previously unpublished revisions.

	Number in figure 1	Number of wells constructed in 1991: Total	Number of wells constructed in 1991: Diameter of 12 inches or more	Estimated withdrawals from wells (acre-feet), 1991: Irrigation	1991: Industry	1991: Public supply	1991: Domestic and stock	1991: Total (rounded)	1990 total	1982-86 average annual	1987-91 average annual
Curlew Valley	3	1	1	36,800	0	50	50	37,000	43,000	23,000	34,000
Cache Valley	5	59	0	11,000	7,200	8,600	1,900	29,000	32,000	22,000	30,000
East Shore area	9	147	4	[1]25,000	8,500	29,400	5,000	68,000	65,000	53,000	66,000
Salt Lake Valley	10	395	12	2,500	[2]38,600	69,200	25,000	135,000	[3]143,000	108,000	144,000
Tooele Valley	11	27	0	[1]24,800	1,800	3,500	300	30,000	33,000	23,000	28,000
Utah and Goshen Valleys	14	125	0	61,400	5,700	36,700	20,600	124,000	129,000	80,000	118,000
Juab Valley	19	6	0	23,600	90	[4]1,500	300	25,000	27,000	10,000	25,000
Sevier Desert	22	32	0	26,100	6,000	2,100	300	34,000	34,000	12,000	23,000
Central Sevier Valley	20	[10]33	0	15,100	100	1,000	2,200	18,000	18,000	18,000	18,000
Pahvant Valley	21	2	1	72,900	0	1,180	300	74,000	88,000	55,000	76,000
Cedar Valley, Iron County	29	19	2	29,300	600	3,600	300	34,000	30,000	22,000	27,000
Parowan Valley	28	5	4	[5]31,000	0	800	150	32,000	31,000	24,000	27,000
Escalante Valley											
Milford area	24	5	3	47,500	[6]5,600	630	250	54,000	48,000	44,000	46,000
Beryl-Enterprise area	30	17	5	77,000	600	400	750	79,000	86,000	95,000	87,000
Central Virgin River area	31	30	2	3,500	8,100	10,000	250	22,000	22,000	21,000	21,000
Other areas[7, 9]		378	9	54,700	23,300	27,000	6,200	111,000	[3]111,000	76,000	99,000
Totals (rounded)		[8]1,281	43	542,000	106,000	196,000	64,000	906,000	[3]940,000	686,000	869,000

[1] Includes some domestic and stock use.
[2] Includes some use for air conditioning, about 30 percent of which is reinjected into the aquifer.
[3] Previously unreported revision.
[4] Includes some industrial use.
[5] Includes some use for stock.
[6] Withdrawal for geothermal power generation. Approximately 5,500 acre-feet was reinjected.
[7] Withdrawals are estimated minimum. See page 78 for withdrawal estimates for other areas.
[8] Includes 494 wells drilled for new appropriations of ground water and 52 replacement wells. Data from Division of Water Rights, Utah, Department of Natural Resources.
[9] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in previous reports of this series.
[10] Includes wells constructed in upper Sevier Valley and upper Fremont River Valley.

Table 3.—***Total annual withdrawal of water from wells in major areas of ground-water development in Utah, 1981-90***

[From previous reports of this series]

Area	Number in figure 1	Thousands of acre-feet										
		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1981-90 average (rounded)
Curlew Valley	3	40	26	18	20	27	26	29	34	29	43	29
Cache Valley	5	33	26	20	21	22	23	26	33	[1]30	32	27
East Shore area	9	36	38	43	49	67	66	67	68	61	65	56
Salt Lake Valley	10	127	115	110	102	110	104	122	[1]165	[1]157	[1]143	126
Tooele Valley	11	30	26	22	23	22	21	22	26	27	33	25
Utah and Goshen Valleys	14	101	86	74	78	88	75	104	113	121	129	97
Juab Valley	19	21	16	6	6	11	10	22	22	28	27	17
Sevier Desert	22	18	16	8	10	13	11	15	15	17	34	16
Central Sevier Valley [2]	20	21	23	17	16	17	18	18	17	18	18	18
Pahvant Valley	21	83	70	42	42	62	60	66	71	82	88	67
Cedar Valley, Iron County	29	29	28	21	20	23	19	21	20	28	30	24
Parowan Valley	28	27	25	22	22	25	24	22	20	29	31	25
Escalante Valley												
Milford area	24	69	55	39	32	49	46	44	40	46	48	47
Beryl-Enterprise area	30	93	99	86	95	100	93	97	88	85	86	92
Central Virgin River area [3]	31	22	27	16	19	21	20	20	18	23	22	21
Other areas		87	105	56	68	81	72	79	95	100	[1]111	85
Totals		837	781	600	623	738	688	774	[1]845	[1]881	[1]940	772

[1]Previously unpublished revision.
[2]Previously included upper Sevier and upper Fremont River valleys.
[3]Prior to 1984 included under 'Other Areas'.

Withdrawals during 1991 in 14 of the 16 areas exceeded the 1981-90 average annual withdrawals for each area. The average annual withdrawals during 1987-91 for 13 of the 16 areas also exceeded the average annual withdrawals for the preceding 5-year period, 1982-86. Average annual withdrawal in the central Sevier Valley was the same in 1987-91 as in 1982-86 (tables 2 and 3).

The quantity of water withdrawn from wells is related to demand and availability of water from other sources, which in turn are related partly to local climatic conditions. Calendar year 1988 was the first year of generally less-than-average precipitation in Utah after six years of greater-than-average-precipitation. The trend of less-than-average precipitation has continued through 1991. Of the 32 weather stations throughout Utah for which average annual precipitation values and graphs of cumulative departure from average annual precipitation are included in this report, 17 stations recorded precipitation in 1991 that was less than the long-term average annual value. The largest negative departure from average precipitation was the 2.19 inches recorded at Roosevelt. The highest above average precipitation in 1991 was the 7.81 inches recorded at the Ogden Pioneer Powerhouse station.

Average annual precipitation during the five-year period 1987-91 was lower than in the preceding five-year period 1982-86 at all of the 32 weather stations included in this report—the average difference for the 32 stations is 6.12 inches. This generally lower precipitation in the State during 1987-91 as compared with 1982-86 resulted in less recharge to the ground-water reservoirs. This, coupled with increased withdrawals for industrial use and continued large withdrawals for irrigation and public supply, resulted in declines in ground-water levels in most parts of the major areas of ground-water development in the State from the spring of 1987 to the spring of 1992.

No rises in water levels were observed from March 1987 to March 1992 in Sanpete Valley and Parowan Valley. Water levels rose in parts of the other 14 valleys, possibly because of local decreases in withdrawals.

The total number of wells drilled during 1991, 1,281 (table 2), taken from reports by well drillers filed with the Utah Division of Water Rights, is 273 more than was reported for 1990 and 818 more than was reported in 1989. Of the 1,281 wells drilled in 1991, 494 were for new appropriations of ground water and 52 were replacement wells. The remaining 735 wells include test and monitoring wells. Forty-three large-diameter wells (12 inches or more), mostly for withdrawal of water for public supply, irrigation, and industrial use, were drilled in 1991.

The areas of ground-water development specifically referred to in this report are shown in figure 1. Information about well construction and withdrawal of water from wells in Utah for four major use categories during 1991 is presented in table 2. Total annual withdrawals from wells in the major areas of ground-water development in Utah for 1981-90 are shown in table 3.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

by J. D. Sory

Withdrawal of water from wells in Curlew Valley in 1991 was approximately 37,000 acre-feet, a decrease of 6,000 acre-feet from the quantity reported for 1990 and 8,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). The 1990 value is the largest annual withdrawal on record. The average annual withdrawal for the 1987-91 period was 11,000 acre-feet more than for the preceding five-year period, 1982-86 (table 2). The increased withdrawals were for irrigation.

Water levels in Curlew Valley generally declined from March 1987 to March 1992 with the largest declines of as much as 25 feet, west of Snowville (fig. 2). The declines probably are the result of the increased withdrawals for the 1987-91 period compared with the previous five-year period, and decreased recharge due to less precipitation during the 1987-91 period (an average of 11.10 inches at Snowville) as compared with the 1982-86 average (16.42 inches). Water levels did rise slightly in the western part of the valley (fig. 2). This rise was probably the result of a decrease in local ground-water withdrawals.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Snowville, to annual withdrawals from wells, and to concentration of dissolved solids in water from a well northwest of Snowville is shown in figure 3. Precipitation in 1991 was 12.47 inches, which is 0.13 inches greater than the average annual precipitation for 1941-91. The average precipitation for the last five years (1987-91), however, is 1.87 inches less than the 1941-91 average. The hydrographs for wells (B-14-9)7bbb-1 in the irrigated area near Snowville and (B-12-11)16cdc-1 near the irrigated area of Kelton are representative of the ground-water levels in those areas, and show the effects of both precipitation/recharge and withdrawals for irrigation.

The concentration of dissolved solids in water from well (B-15-9)28cbc-1 increased during 1974-90 from about 2,500 milligrams per liter to more than 4,200 milligrams per liter. Two possible causes of this increase are movement of saline water toward the well because of water-level declines in the area and recharge from irrigation in which dissolved solids in the water have been concentrated by evaporation.

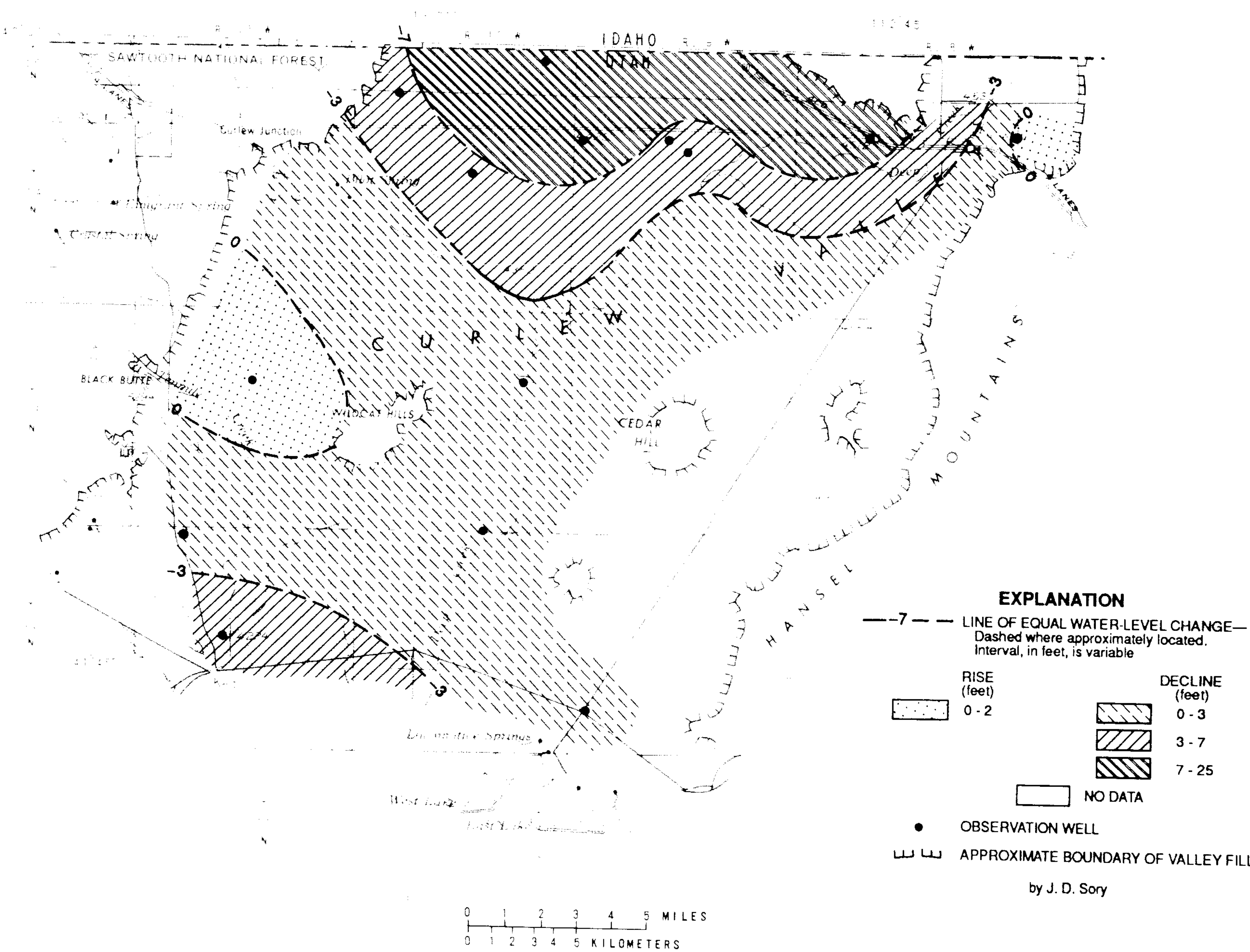


Figure 2.–Map of Curlew Valley showing change of water levels from March 1987 to March 1992.

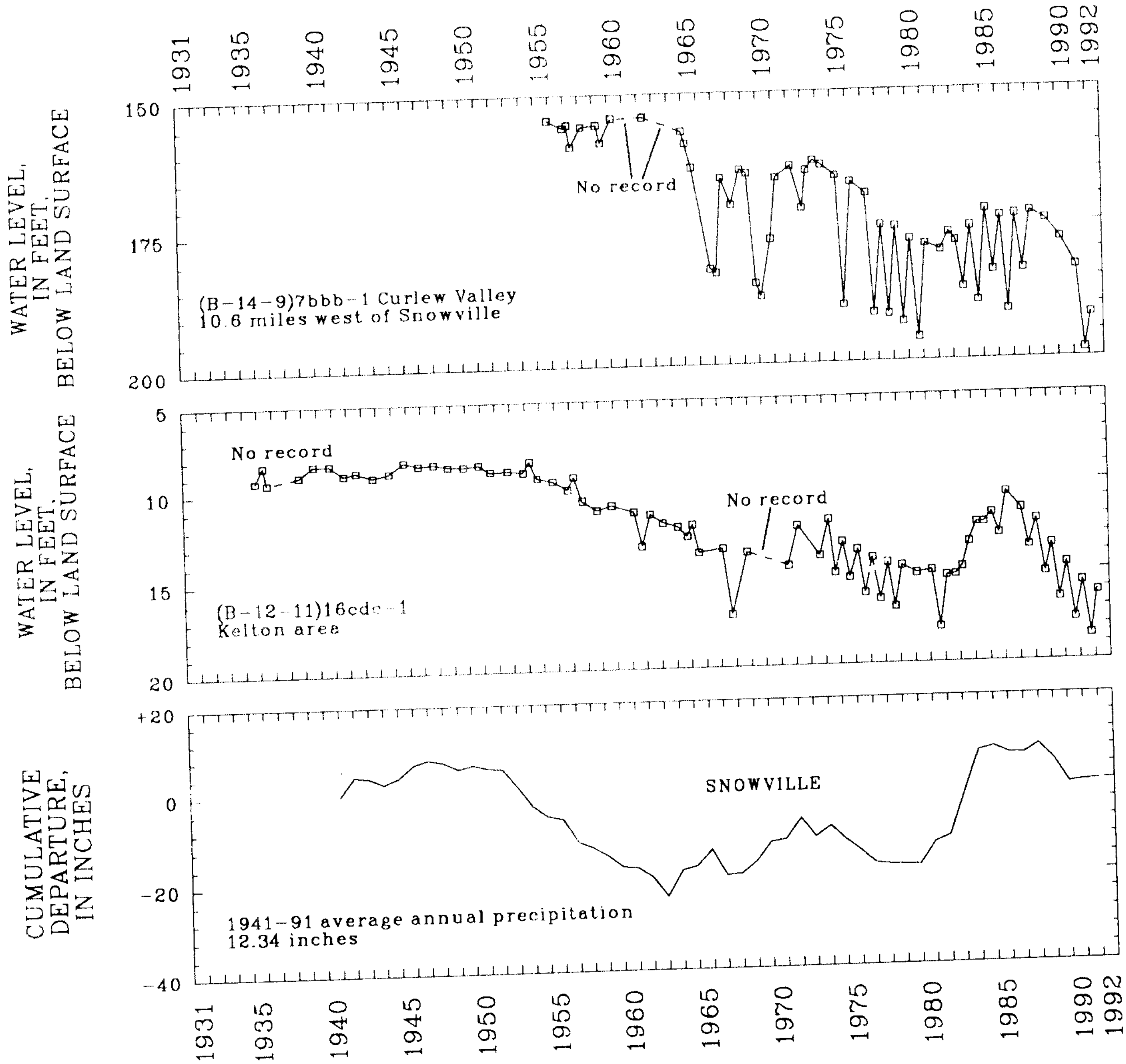


Figure 3.—Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B−15−9)28cbc−1.

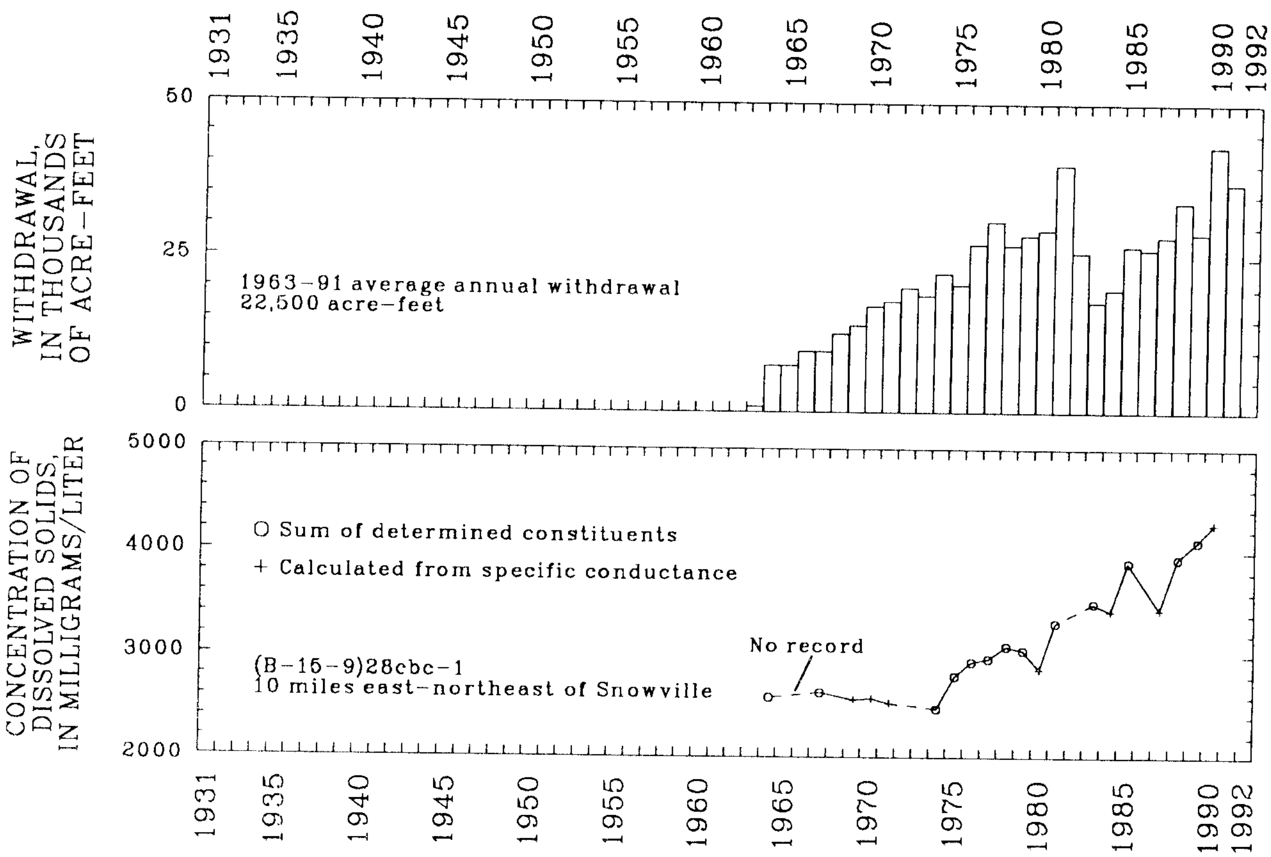


Figure 3.--Continued

CACHE VALLEY

by Karen M. Hanson

Withdrawal of water from wells in Cache Valley in 1991 was approximately 29,000 acre-feet. This was 3,000 acre-feet less than was reported for 1990 (table 2) and 2,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). The average annual withdrawal for the 1987-91 period was 8,000 acre-feet more than during the preceding five-year period, 1982-86 (table 2). The decreased withdrawal in 1991 was mostly due to decreased withdrawals for irrigation and public supply.

Water levels declined from March 1987 to March 1992 in almost all of Cache Valley, with the largest declines, as much as 12 feet, occurring not only near, but also north and south of Logan (fig. 4). The declines probably [illegible] result of below-average [illegible] of the previous five years, which probably resulted in a decrease in recharge, and the increased withdrawals during the 1987-91 period compared with the previous five-year period.

The long-term record of water levels in wells (A-12-1)29cab-1 and (A-13-1)29adc-1, annual discharge of the Logan River near Logan, cumulative departure from annual precipitation at the Logan Utah State University (USU) Station, annual withdrawals from wells, and concentration of dissolved solids in water from well (A-11-1)8dda-3 are shown in figure 5.

Discharge of the Logan River during 1991 was about 117,500 acre-feet, which is approximately 19,200 acre-feet more than the 98,300 acre-feet (revised) for 1990 but only 64 percent of the 1941-91 average annual discharge.

Annual precipitation at Logan USU was [illegible] inches in 1991. This was 5.37 inches more than the revised quantity for 1990, and 1.66 inches more than the 1941-91 average annual precipitation. The average precipitation for the period 1987-91, 15.92 inches, was 10.96 inches less than the average for the preceding five years, 1982-86.

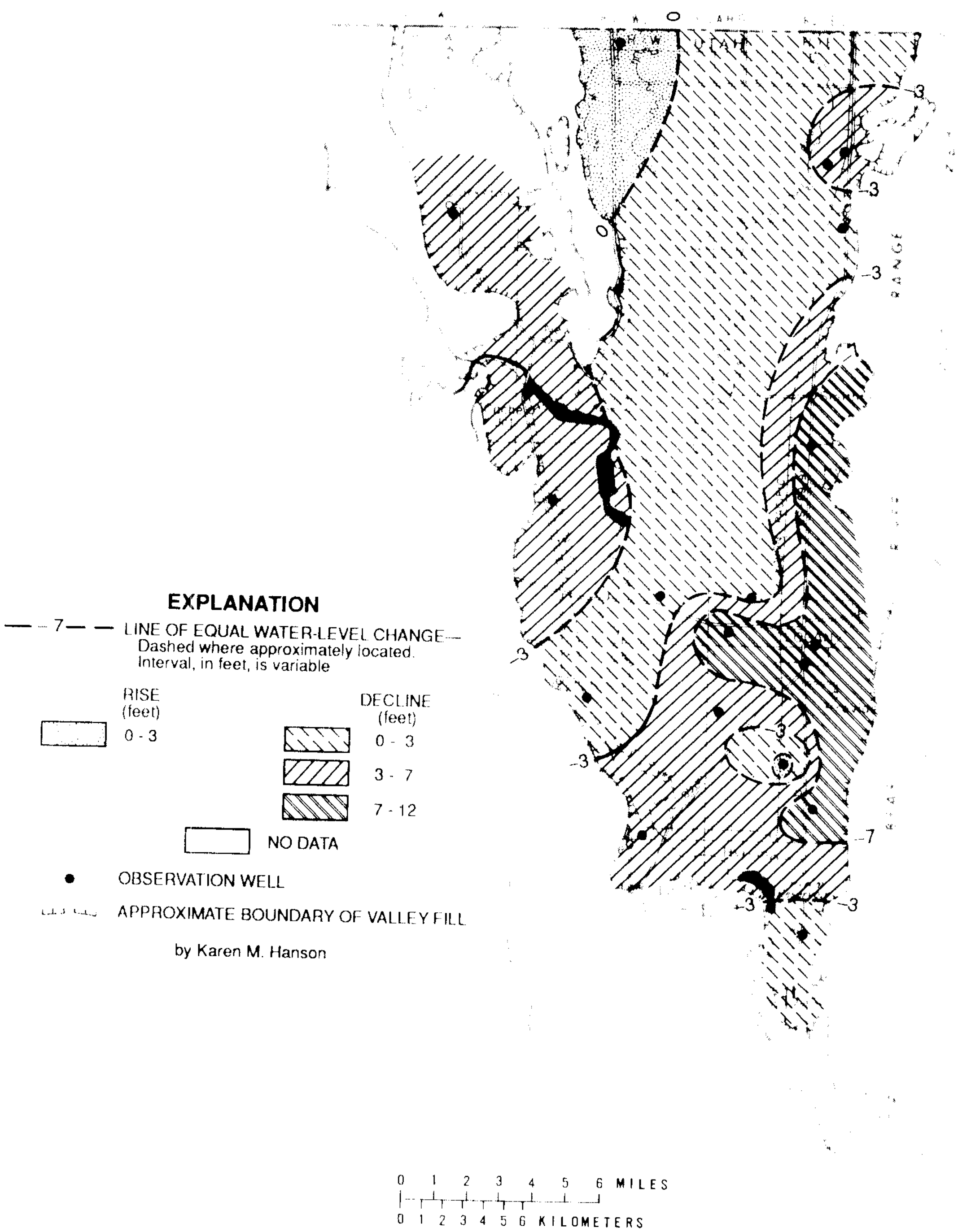


Figure 4.--Map of Cache Valley showing change of water levels from March 1987 to March 1992.

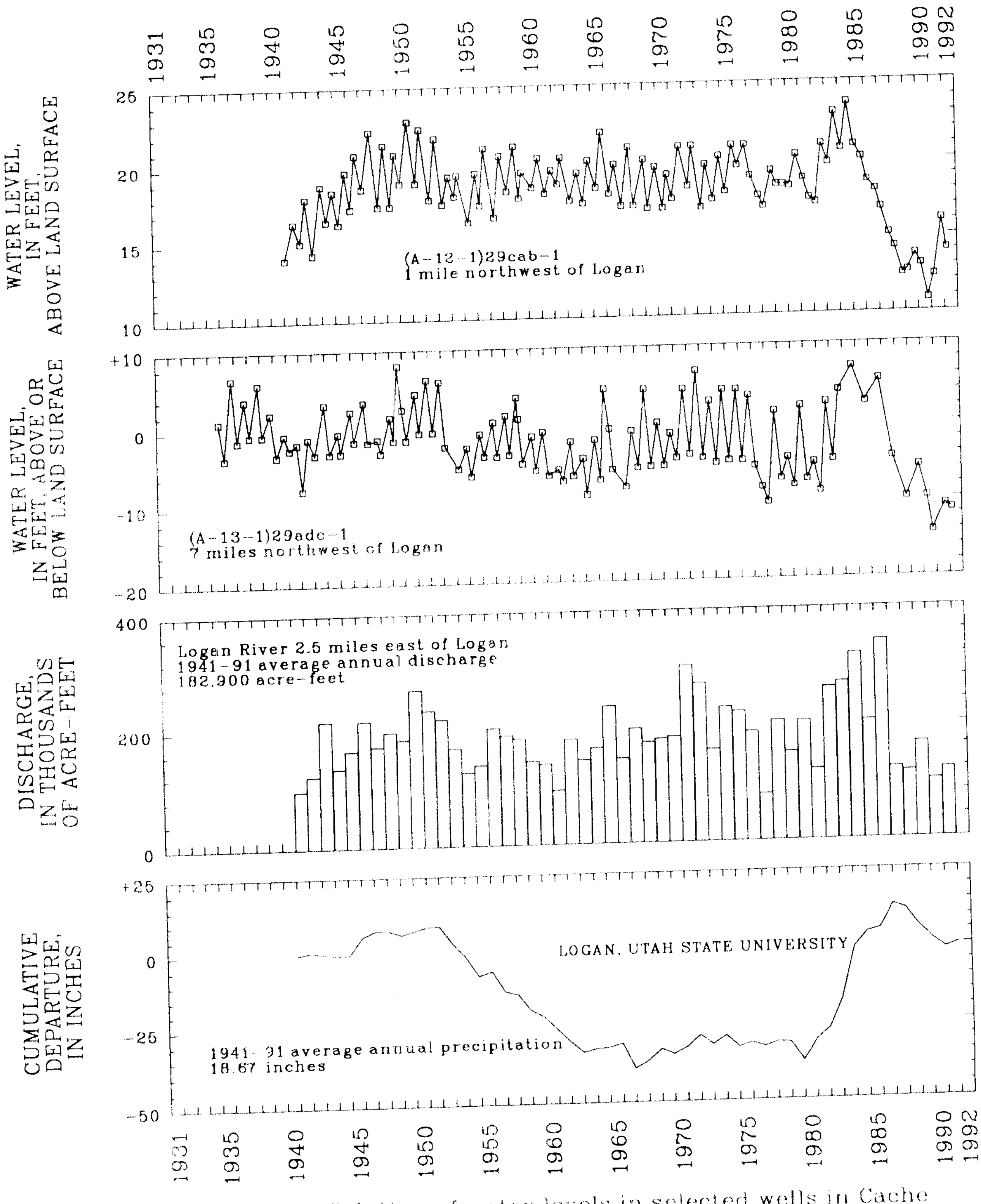


Figure 5.—Relation of water levels in selected wells in Cache Valley to discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3.

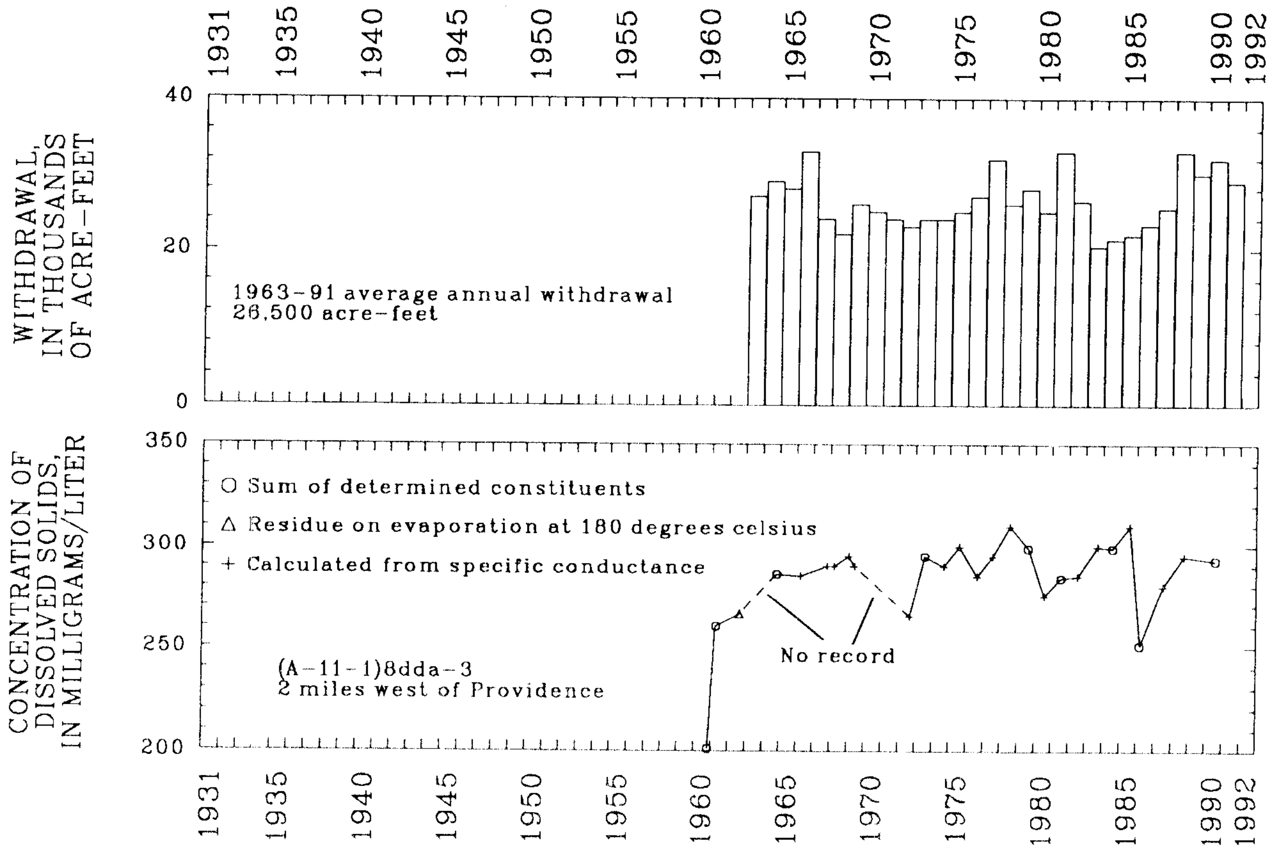


Figure 5.--Continued

EAST SHORE AREA

by James P. Eads

Withdrawal of water from wells in the East Shore area in 1991 was approximately 68,000 acre-feet, 3,000 acre-feet more than was reported for 1990 (table 2) and 12,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). Withdrawal for public supply was 29,400 acre-feet or about 2,400 acre-feet greater than in 1990, industrial withdrawal decreased by 1,500 acre-feet, and irrigation withdrawal increased 1,700 acre-feet. Average annual withdrawals were 13,000 acre-feet more for the five-year period 1987-91, than for the preceding five-year period, 1982-86.

Water levels declined from March 1987 to March 1992 in most of the East Shore area, with the largest declines generally along the east side. The largest decline, about 34 feet, occurred in the Ogden area (fig. 6). The decline in water levels probably is the result of increased withdrawals during 1987-91 compared with the preceding five-year period, and less recharge because precipitation during 1987-91 was less than for the preceding five-year period. Minor rises in water levels of less than 4 feet occurred in the northwestern part of the area.

The relation of water levels in selected observation wells to precipitation at the Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-1)27aba-1 are shown in figure 7. The 1991 precipitation at the Ogden Pioneer Powerhouse was 29.40 inches. The average annual precipitation for 1987-91, 19.34 inches, was 9.50 inches less than the average precipitation of 28.84 inches for the preceding five-year period.

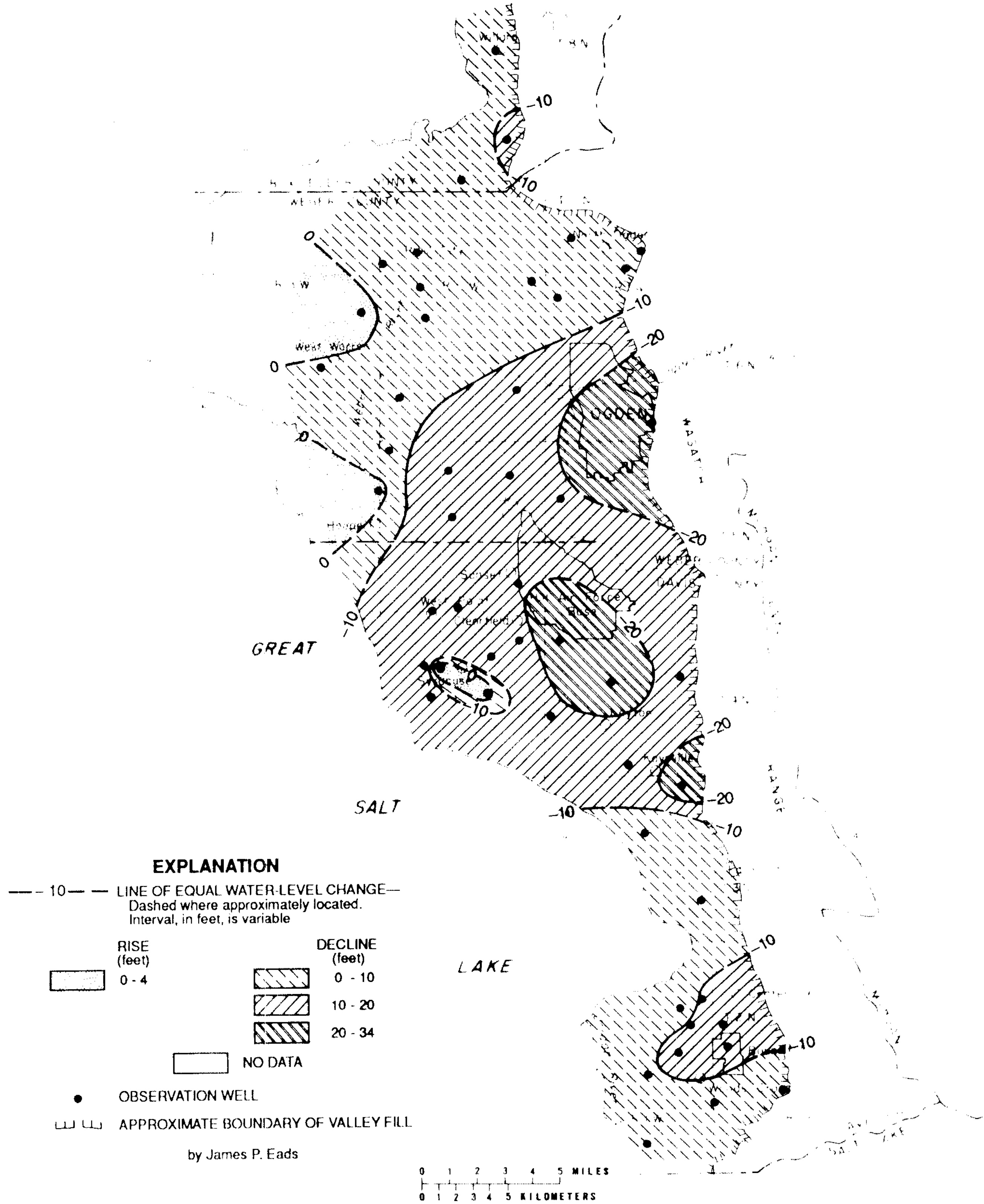


Figure 6.–Map of the East Shore area showing change of water levels from March 1987 to March 1992.

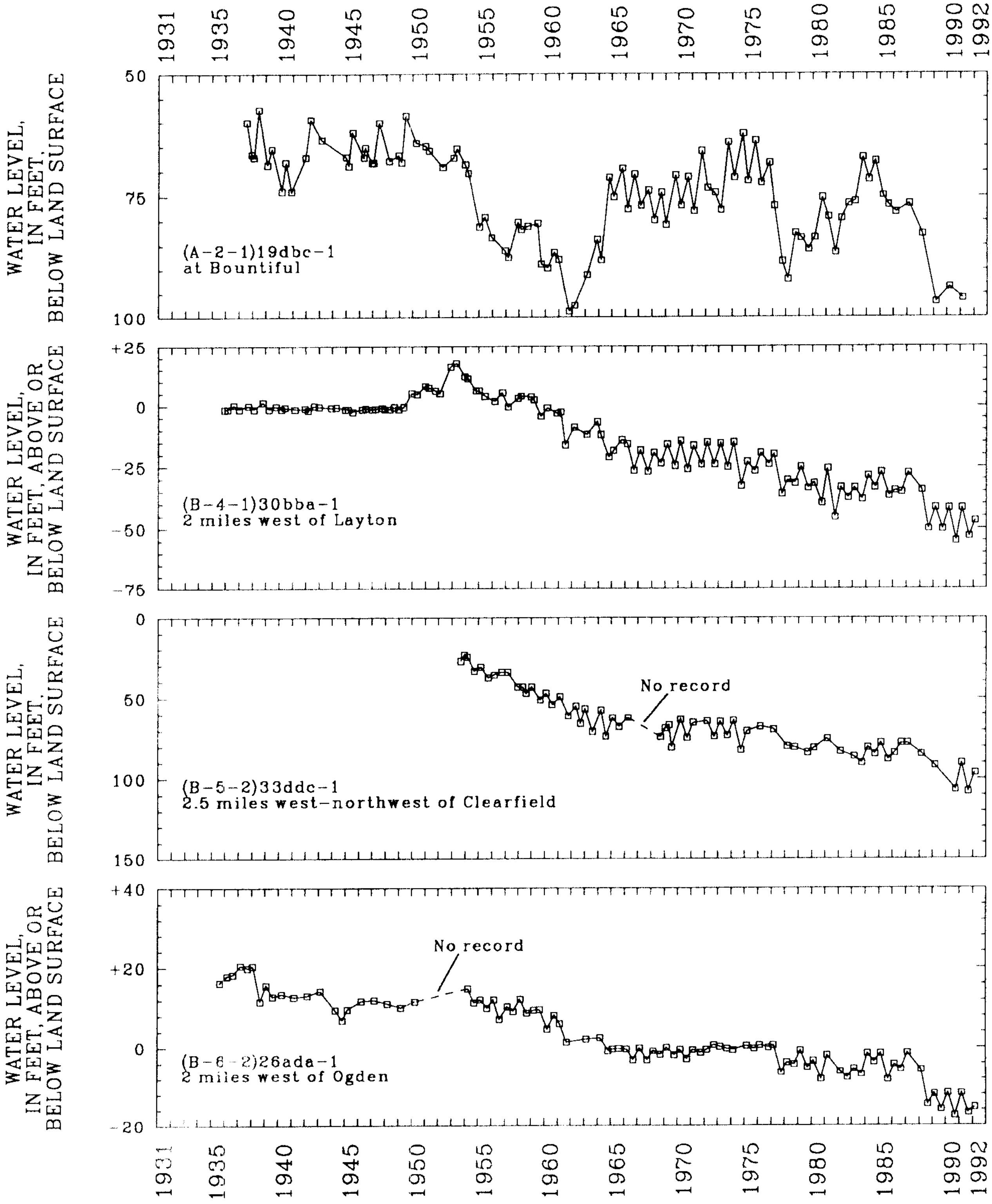


Figure 7.--Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

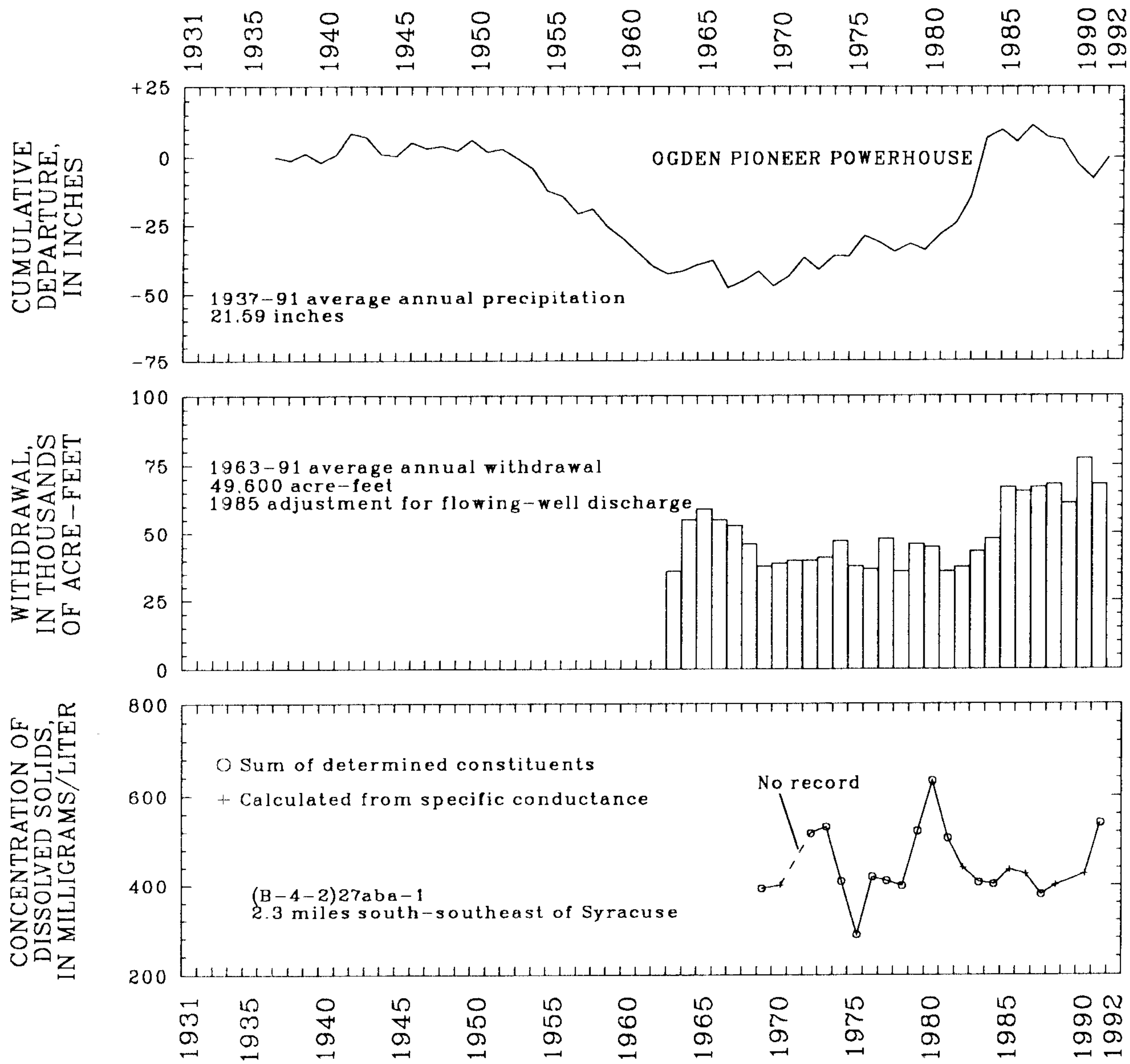


Figure 7.--Continued

SALT LAKE VALLEY

by G. J. Smith

Withdrawal of water from wells in the Salt Lake Valley in 1991 was about 135,000 acre-feet, or about 8,000 acre-feet less than the revised value for 1990, and about 9,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). Withdrawal for public supply was about 69,200 acre-feet, 6,100 acre-feet less than the value for 1990. Withdrawal for industrial use during 1991 was 38,600 acre-feet, 1,400 acre-feet less than the revised quantity for 1990. (Because of recently available data from Kennecott Minerals Co., industrial and total withdrawals were revised for 1988, 1989, and 1990.) The 1987-91 average annual withdrawal, 144,000 acre-feet, is 36,000 acre-feet more than the annual average for the preceding five-year period, 1982-86.

Water levels in the principal aquifer generally declined in most of Salt Lake Valley from February 1987 to February 1992 (fig. 8). The areas of greatest decline were in the eastern part of Sandy, east of Herriman, and in the northern part of Salt Lake City. The largest decline, almost 28 feet, was observed in a well in the eastern part of Sandy. Declines in water levels were probably the result of two principal factors. Withdrawals were larger and recharge to the aquifer was smaller because of less precipitation for the period 1987-91 than during the preceding five-year period (1982-86). Water-level rises occurred mainly in the central parts of the valley. The largest rise, almost 8 feet, occurred north of Murray. Rises in water levels probably were due to local decreases in pumping.

The relation of Salt Lake County population to total annual withdrawals from wells, annual withdrawal for public supply, and precipitation at Salt Lake City Weather Service Office (WSO) (International Airport) is shown in figure 9. Precipitation at the Salt Lake City WSO during 1991 was 17.79 inches, 2.70 inches more than the average annual precipitation for 1931-91 (fig. 9). The average annual precipitation for 1987-91, 12.23 inches, was 8.78 inches less than the average for the previous five-year period, 1982-86.

The relation of water levels in selected wells in the principal aquifer to precipitation at Silver Lake near Brighton, and the relation of chloride concentration and concentration of dissolved solids in water from well (D-1-1)7abd-6 to water levels in this well are shown in figure 10. The 1991 precipitation at Silver Lake near Brighton was 40.41 inches, 2.14 inches less than the average annual precipitation for 1931-91. The average annual precipitation during 1987-91, 35.86 inches, was 18.96 inches less than the annual average for the preceding five-year period, 1982-86.

The chloride concentration from well (D-1-1)7abd-6 (located in Artesian Well Park in Salt Lake City, and used by many people for drinking water), was 130 milligrams per liter in June 1991. This is the same as the highest recorded values measured in 1988 and 1989.

Water levels in selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 11. Water levels in these wells were about the same in February 1992 as they were in February 1987.

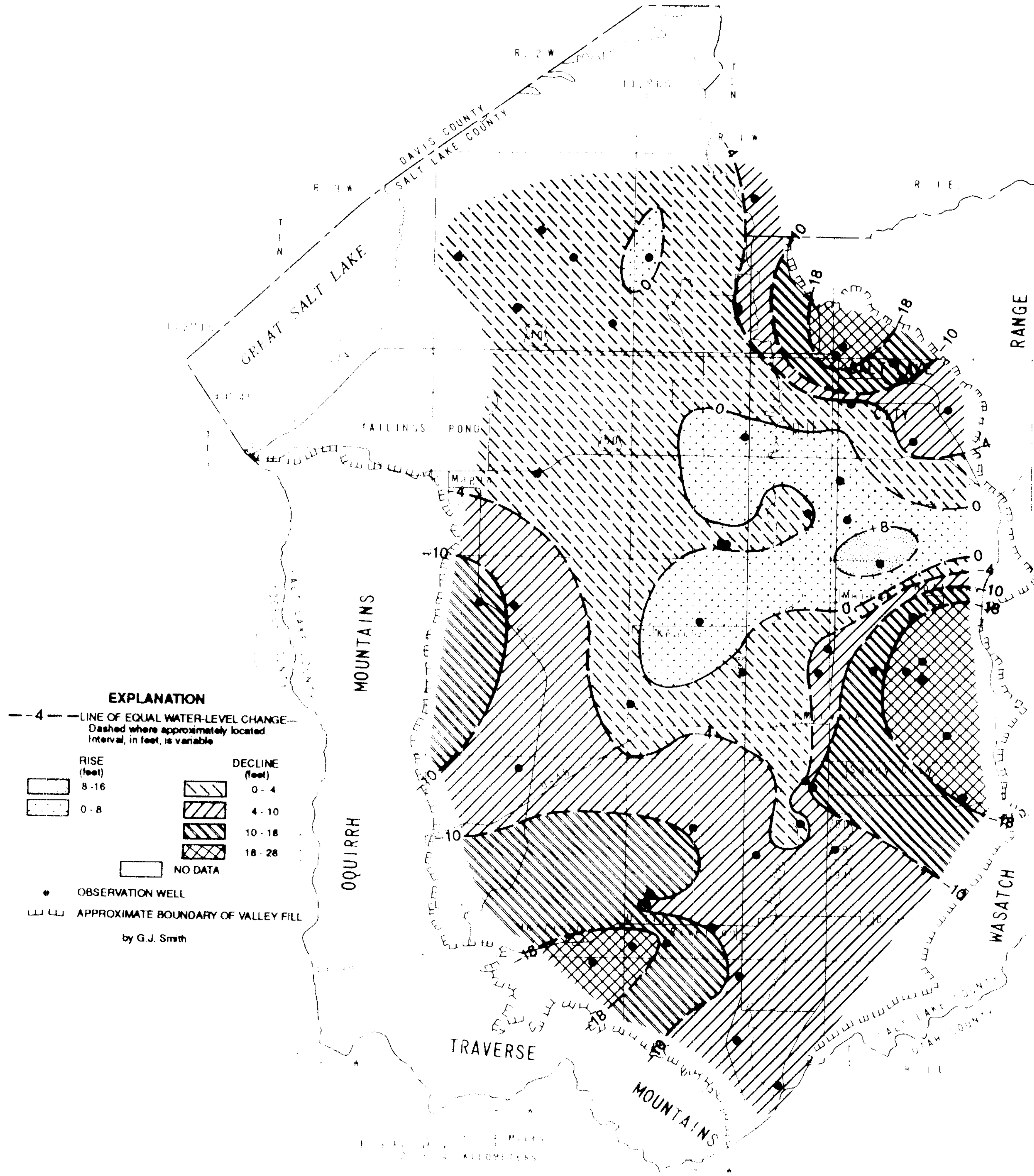


Figure 8.–Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1987 to February 1992.

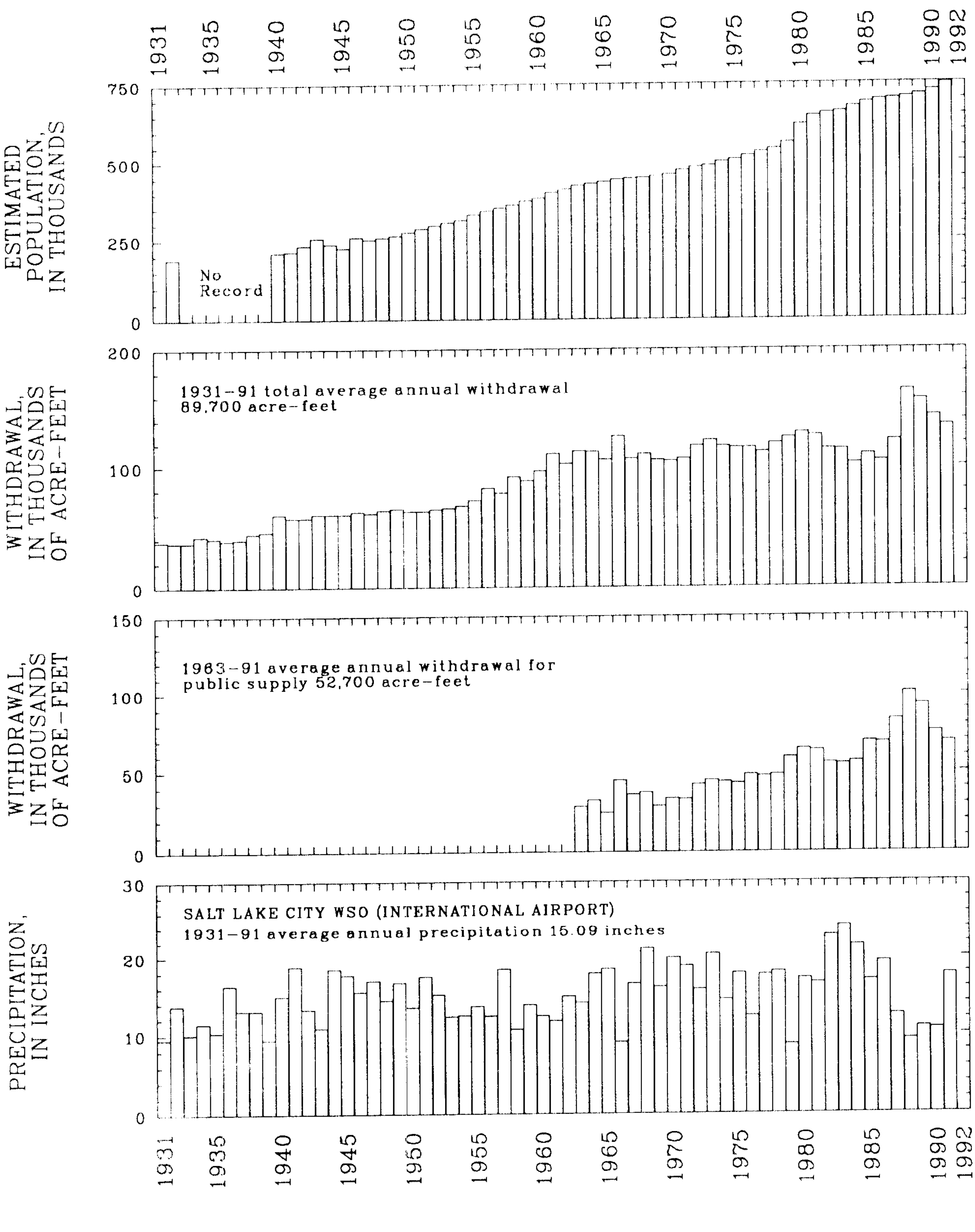


Figure 9.--Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport).

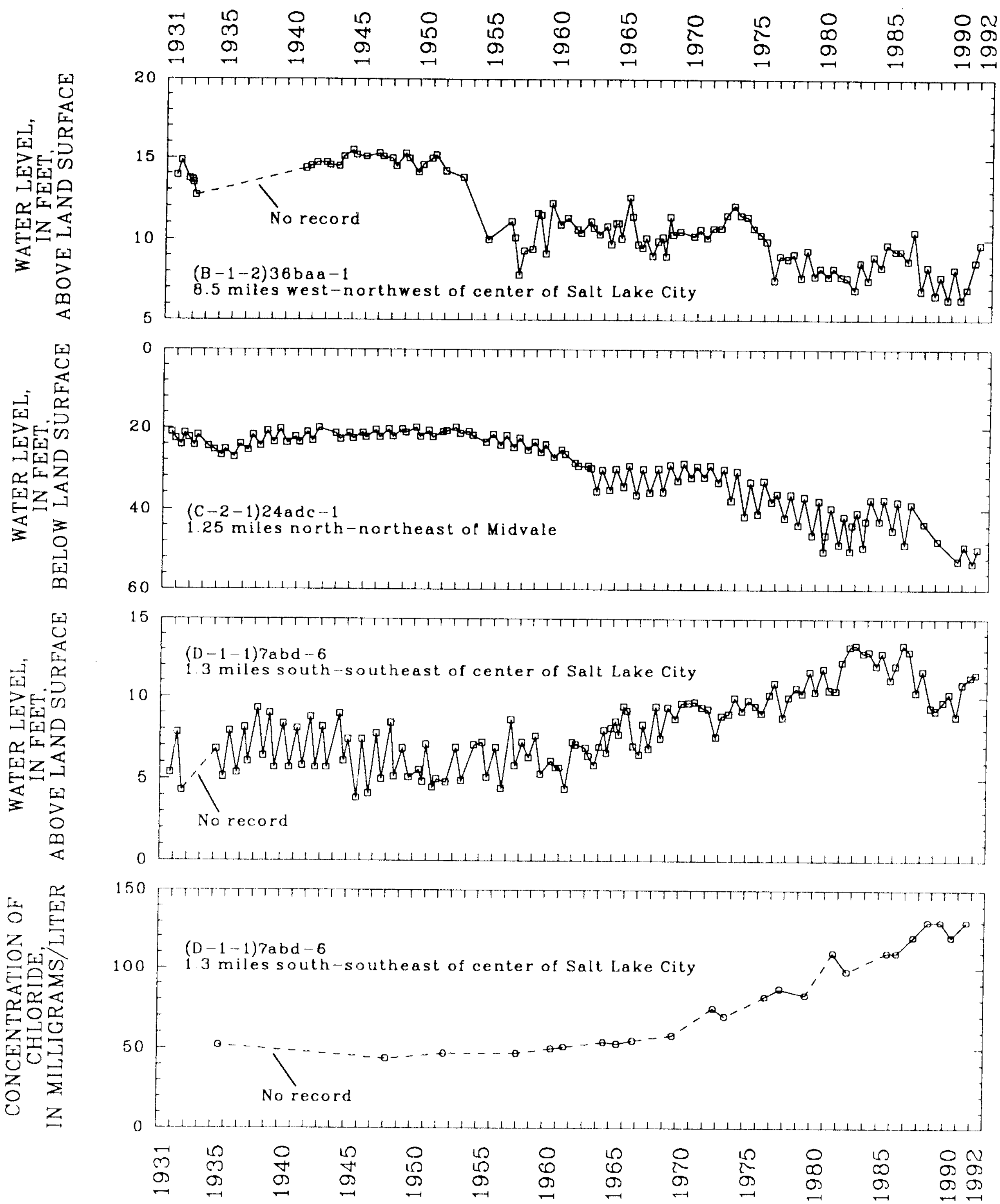


Figure 10.--Graphs showing relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

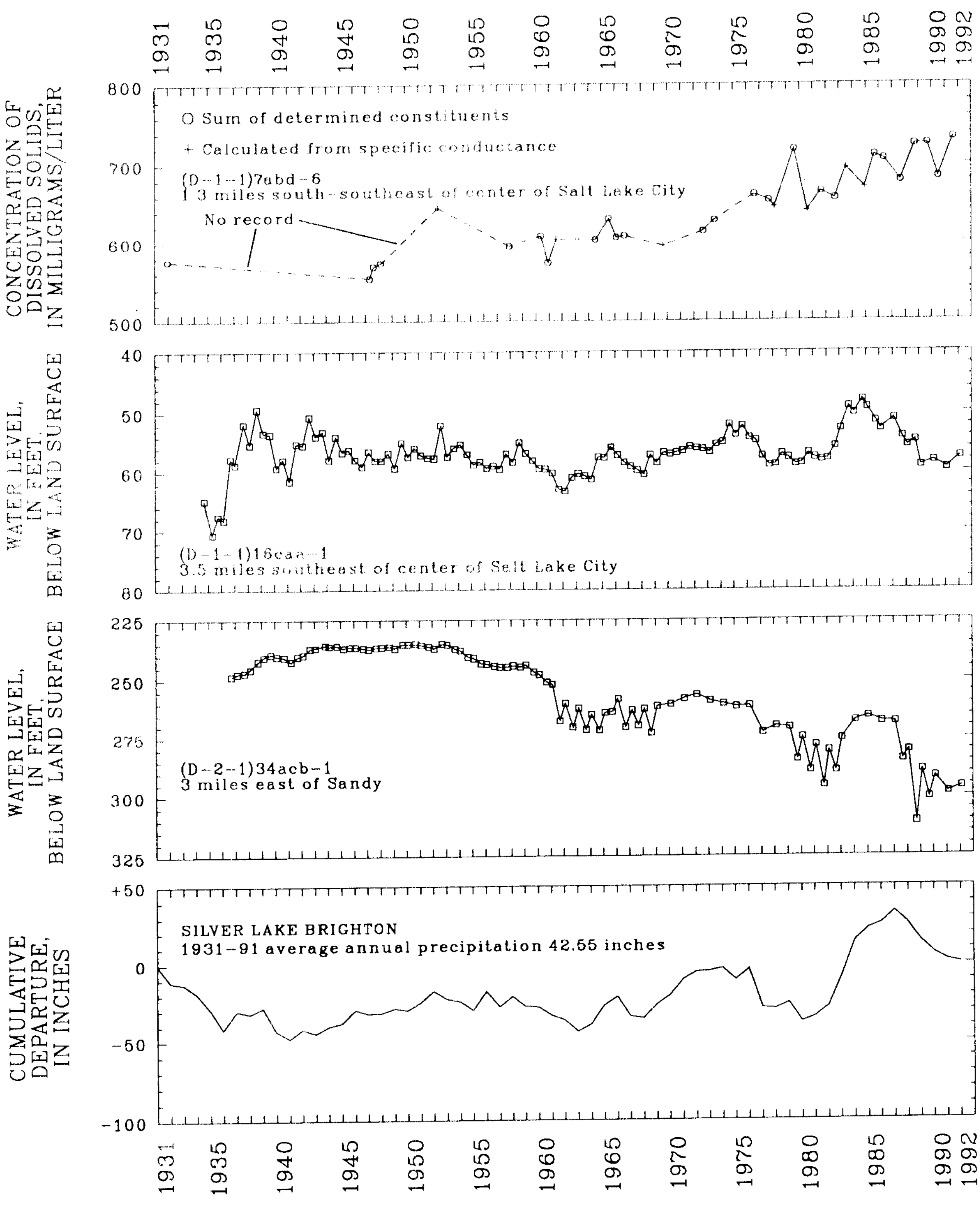


Figure 10.--Continued

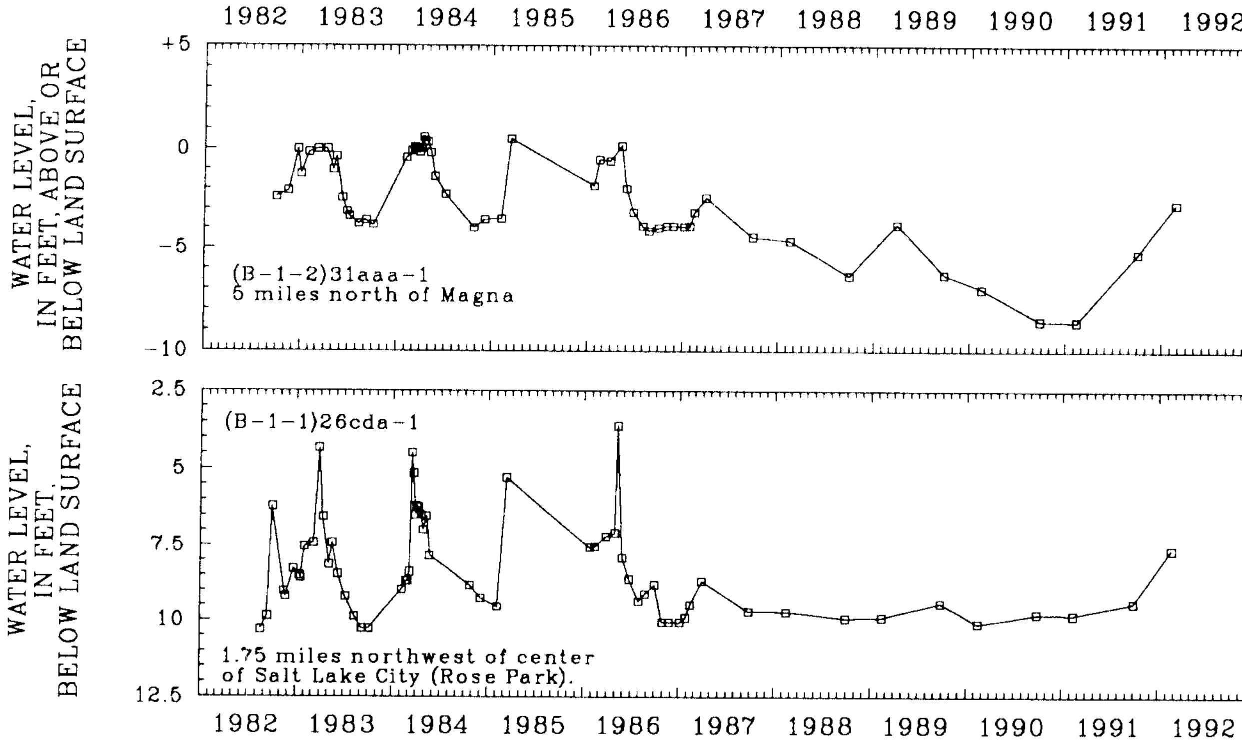


Figure 11.--Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

TOOELE VALLEY

by M. R. Danner

Withdrawal of water from wells in Tooele Valley in 1991 was about 30,000 acre-feet. This is 3,000 acre-feet less than was reported for 1990 (table 2) and 5,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). The decrease in total withdrawal, the first in five years, was due to decreased withdrawals for irrigation and public supply. The average annual withdrawal for the 1987-91 period, 28,000 acre-feet, was 5,000 acre-feet more than for the preceding five-year period, 1982-86 (table 2).

Water levels declined in most of Tooele Valley from March 1987 to March 1992, with the largest declines occurring in the southeastern part of the valley. The maximum decline, of almost 37 feet, was observed northwest of Tooele (fig. 12). These declines are the result of two principal factors. Industrial withdrawals increased and recharge decreased for the 1987-91 period as compared with the previous five-year period, 1982-86. The recharge rate decreased because precipitation for 1987-91 was less than during the preceding five-year period, 1982-86. The average annual precipitation at Tooele for 1987-91, 17.53 inches, was 8.04 inches less than the average for the previous five years, 1982-86. However, precipitation during 1991 at Tooele was 20.96 inches, 3.58 inches more than the average annual precipitation for the period, 1936-91. Water levels rose as much as 2 feet in the northwestern part of Tooele Valley.

The relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentrations of dissolved solids in water from well (C-2-6)23cbb-1 is shown in figure 13. The concentration of dissolved solids in water from well (C-2-6)23cbb-1 has generally declined since 1960, and particularly since 1982.

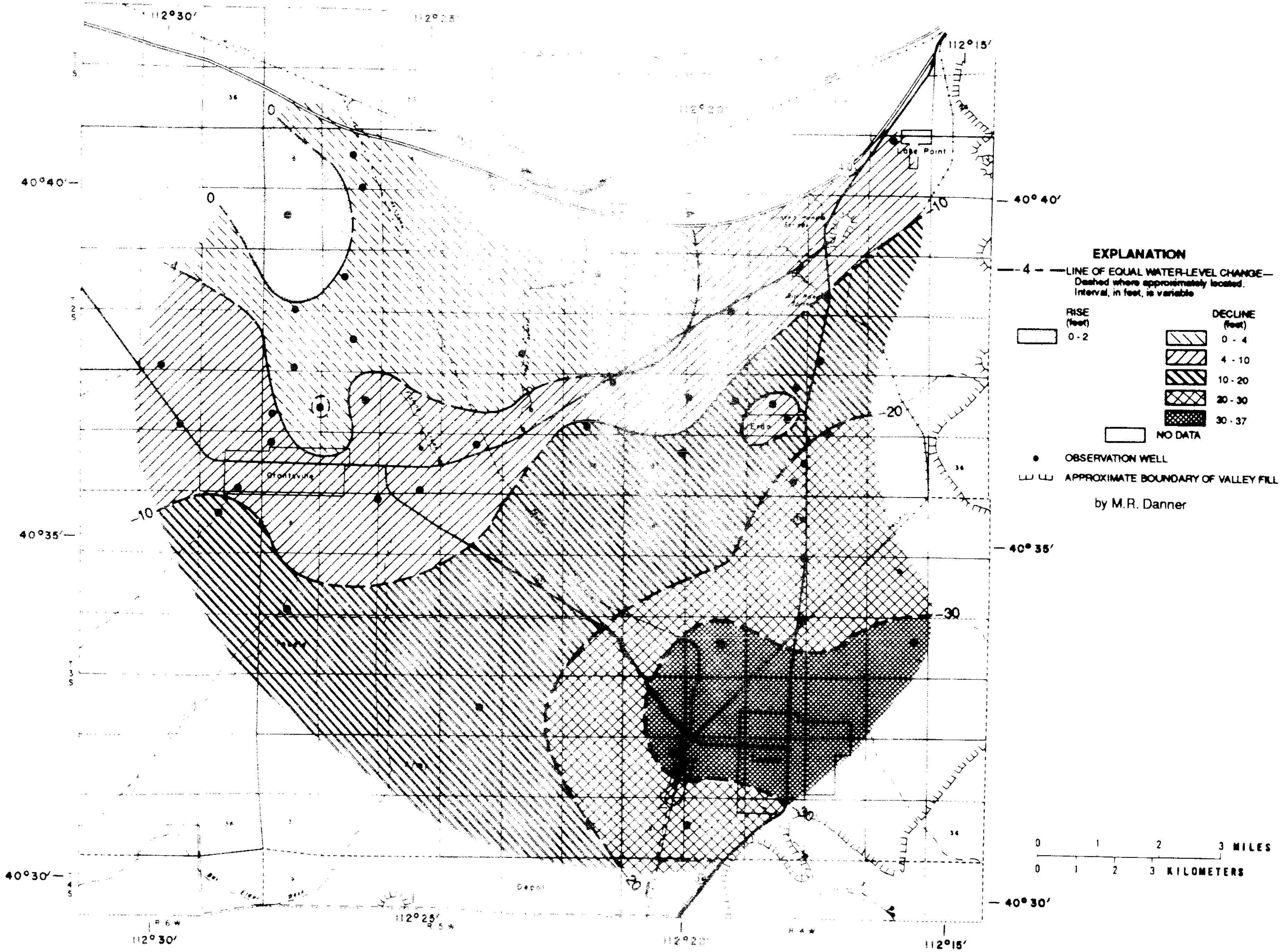


Figure 12.–Map of Tooele Valley showing change of water levels in artesian aquifers from March 1987 to March 1992.

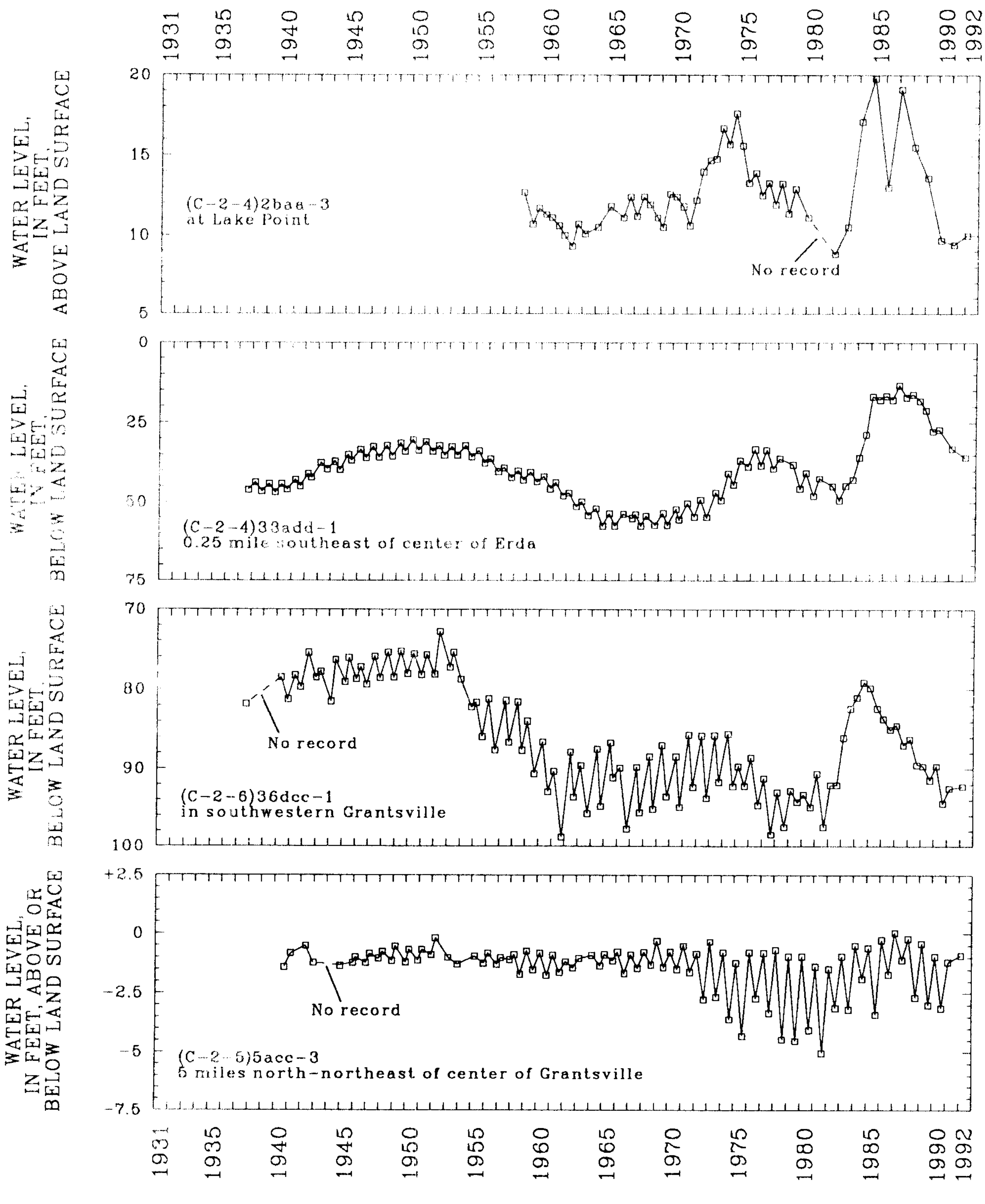


Figure 13.--Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

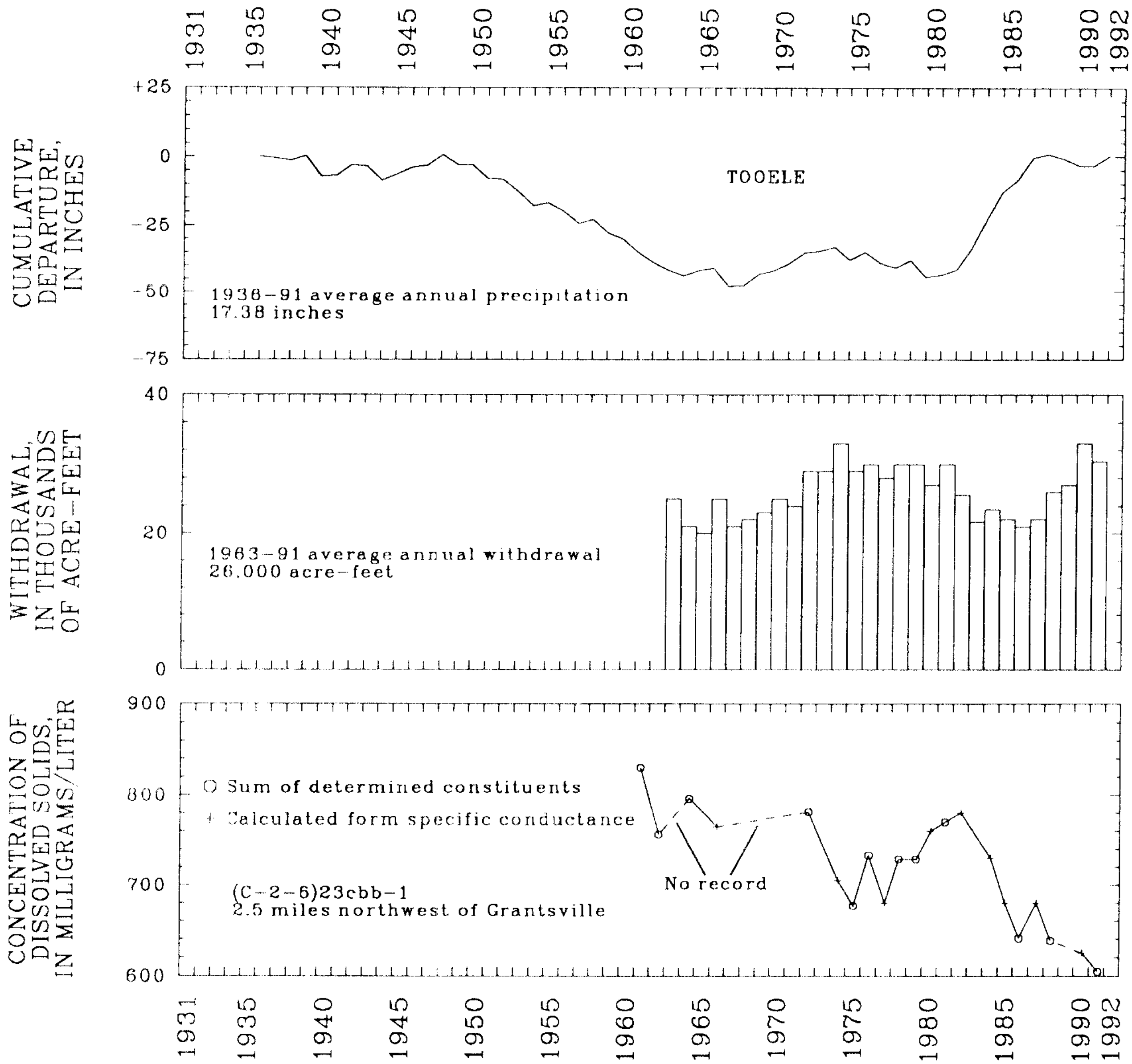


Figure 13.—Continued

UTAH AND GOSHEN VALLEYS

by M. M. Drumiler

Withdrawal of water from wells in Utah and Goshen Valleys in 1991 was about 124,000 acre-feet. This was 5,000 acre-feet less than the withdrawal in 1990, and 27,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). The 1987-91 average annual withdrawal of 118,000 acre-feet was 38,000 acre-feet more than for the preceding five-year period of 1982-86. Withdrawal in Utah Valley was about 108,600 acre-feet, 6,700 acre-feet less than in 1990. Withdrawal in Goshen Valley was about 15,800 acre-feet, 2,100 acre-feet more than in 1990. The decrease in Utah Valley was mainly due to decreased withdrawals for irrigation and public supply. The increase in Goshen Valley was mainly due to increased withdrawals for irrigation.

Water levels declined in all of the aquifers in Utah Valley from March 1987 to March 1992 (figs. 14, 15, 16, 17). The largest decline, almost 41 feet, was recorded south of Alpine in the deep artesian aquifer (fig. 16).

The declines probably were the result of increased withdrawals of water from wells during 1987-91 compared with withdrawals for the preceding five-year period, 1982-86, and decreased recharge resulting from less precipitation during 1987-91 than during the previous five-year period.

Water levels generally rose in the northern part of Goshen Valley from March 1987 to March 1992, and declined in the southern part of the valley (fig. 14). The rise in the northern section may be due to decreased pumpage in the area during 1987-91 compared with pumpage during the preceding five years. The decline in the southern part of Goshen Valley may be due to continued or increased pumpage and decreased recharge because of less precipitation during 1987-91 than in the preceding five-year period.

The relation of water levels in selected observation wells to precipitation, to annual withdrawals from wells, to annual withdrawals for public supply, and to concentration of dissolved solids in water from three wells is shown in figure 18. Precipitation at Timpanogos Cave in 1991 was 28.24 inches, 3.35 inches greater than the 1947-91 average. Precipitation at Spanish Fork Powerhouse for 1991 was 20.11 inches, 0.97 inches greater than the 1937-91 average. Average annual precipitation at Timpanogos Cave during 1987-91 was 20.33 inches, 14.12 inches less than the average during 1982-86. Average annual precipitation at Spanish Fork Powerhouse during 1987-91 was 17.68 inches, 10.92 inches less than the average during 1982-86.

The water level in observation well (D-9-2)11aaa-1 at Salem City rose about 35 feet during 1982-84 and declined more than 46 feet during 1985-1992. The rise approximately corresponded to greater-than-average precipitation during 1981-86 and low rates of withdrawals during 1982-84 and 1986. The decline in water level approximately corresponded to less-than-average precipitation during 1987-91 compared to the previous five years, and to increased withdrawals during 1987-91 as compared with the previous five years. Dissolved-solids concentration in water from well (C-10-1)4cbb-1 increased during 1977-86, and may have decreased since 1986; dissolved-solids concentration in water from well (D-5-1)19ccc-1 generally appears to have decreased since 1957.

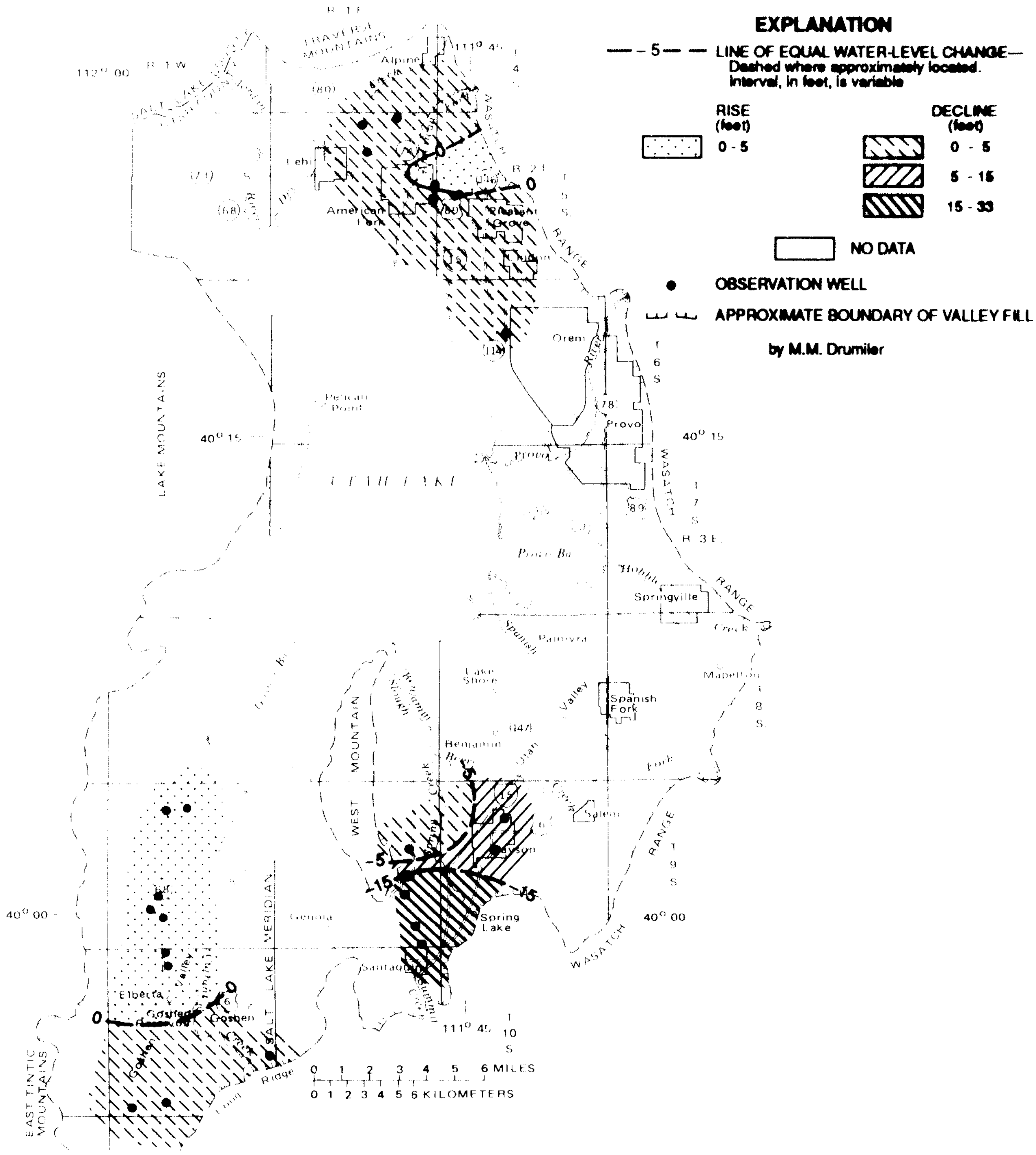


Figure 14.--Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1987 to March 1992.

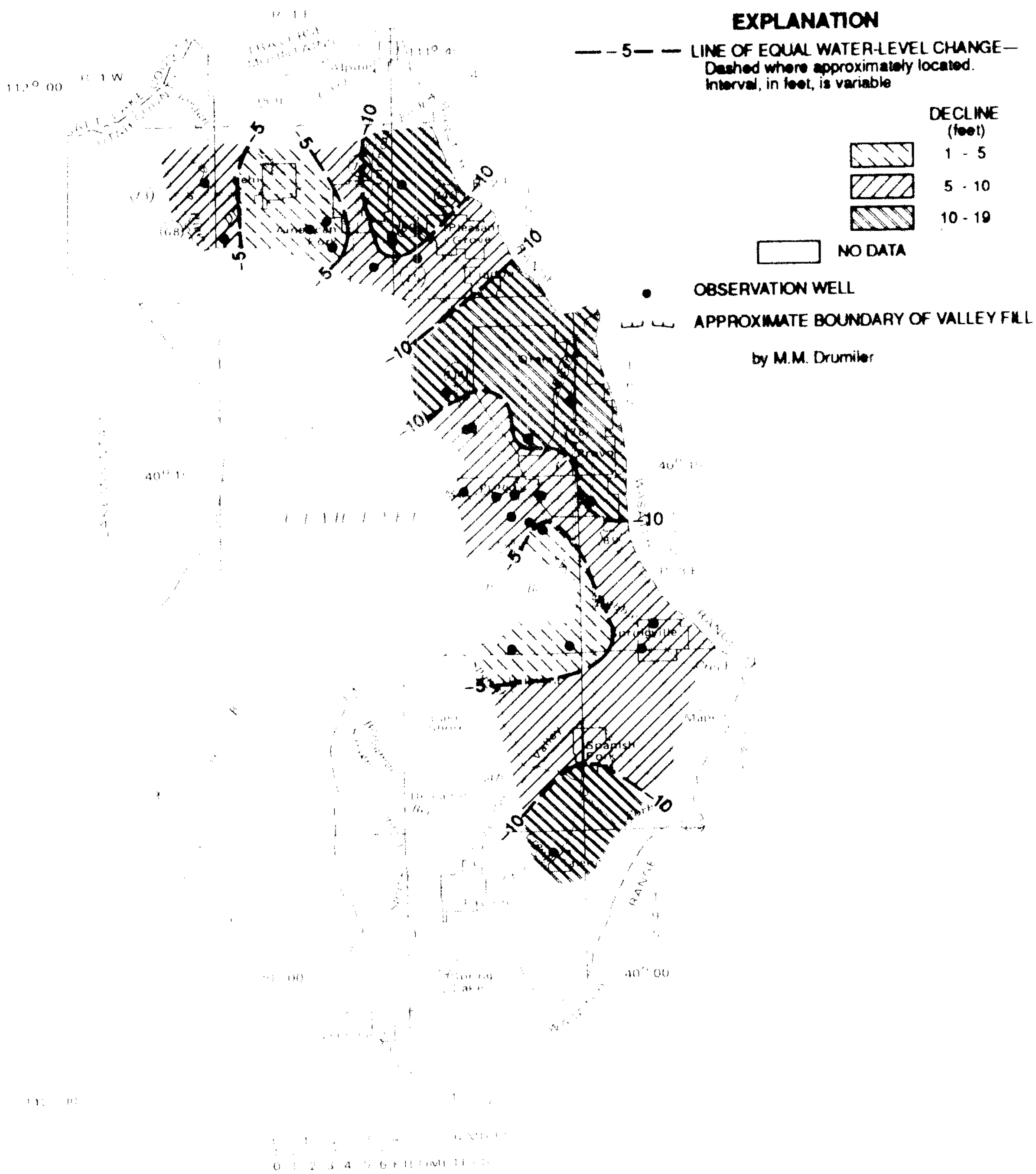


Figure 15.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in deposits of Pleistocene age from March 1987 to March 1992.

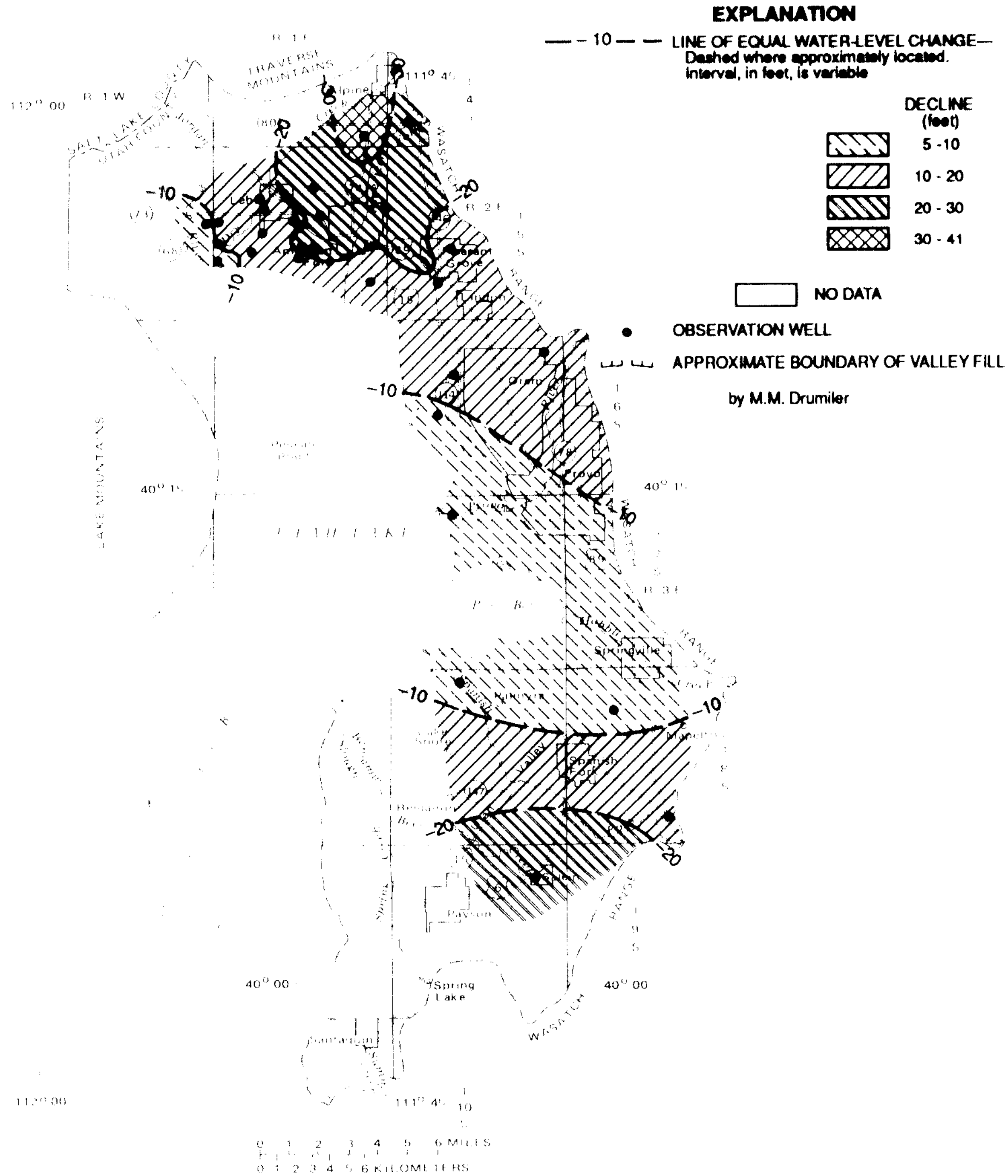


Figure 16.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in deposits of Pleistocene age from March 1987 to March 1992.

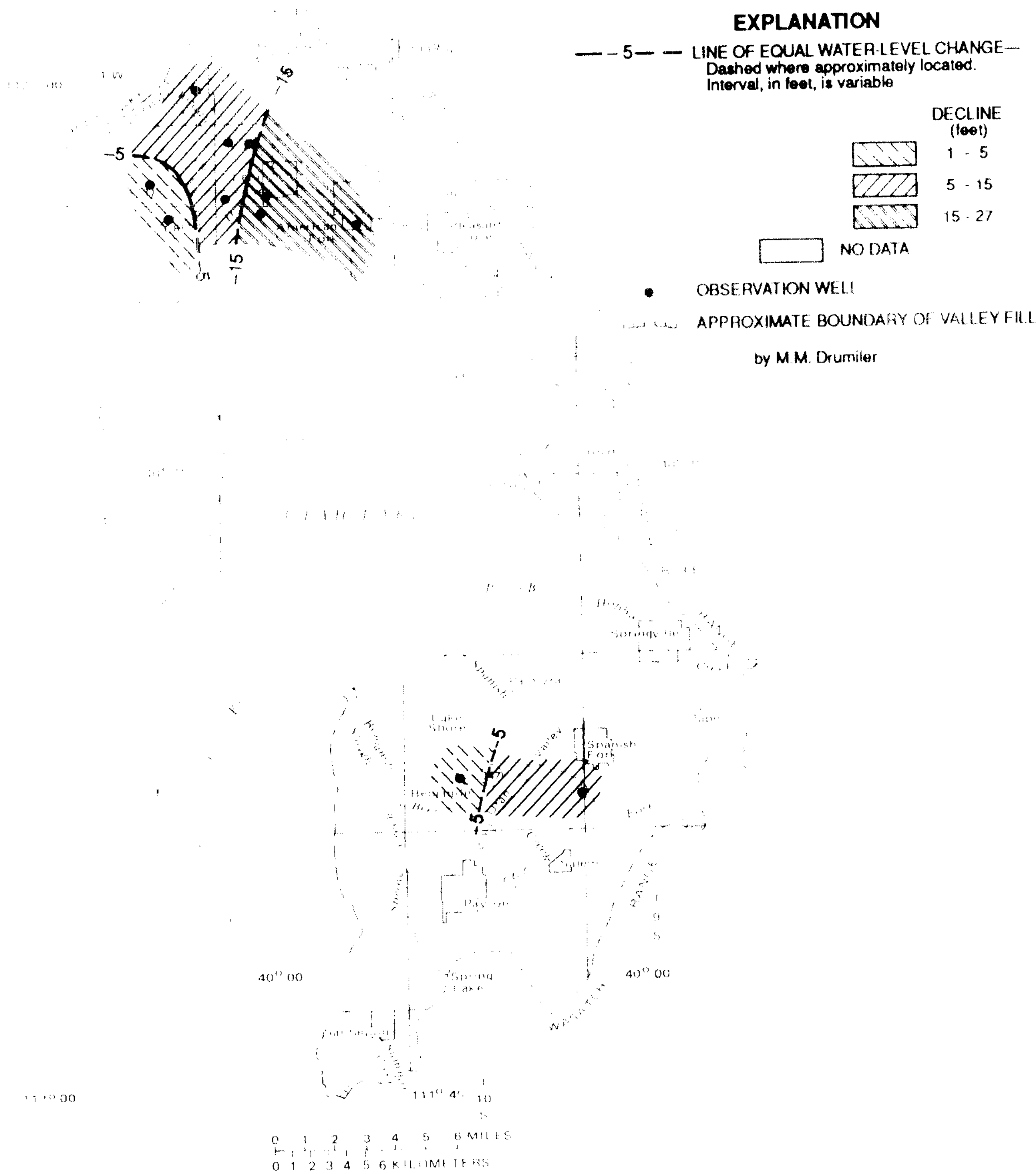


Figure 17.--Map of Utah Valley showing change of water levels in the artesian aquifer in deposits of Quaternary or Tertiary age from March 1987 to March 1992.

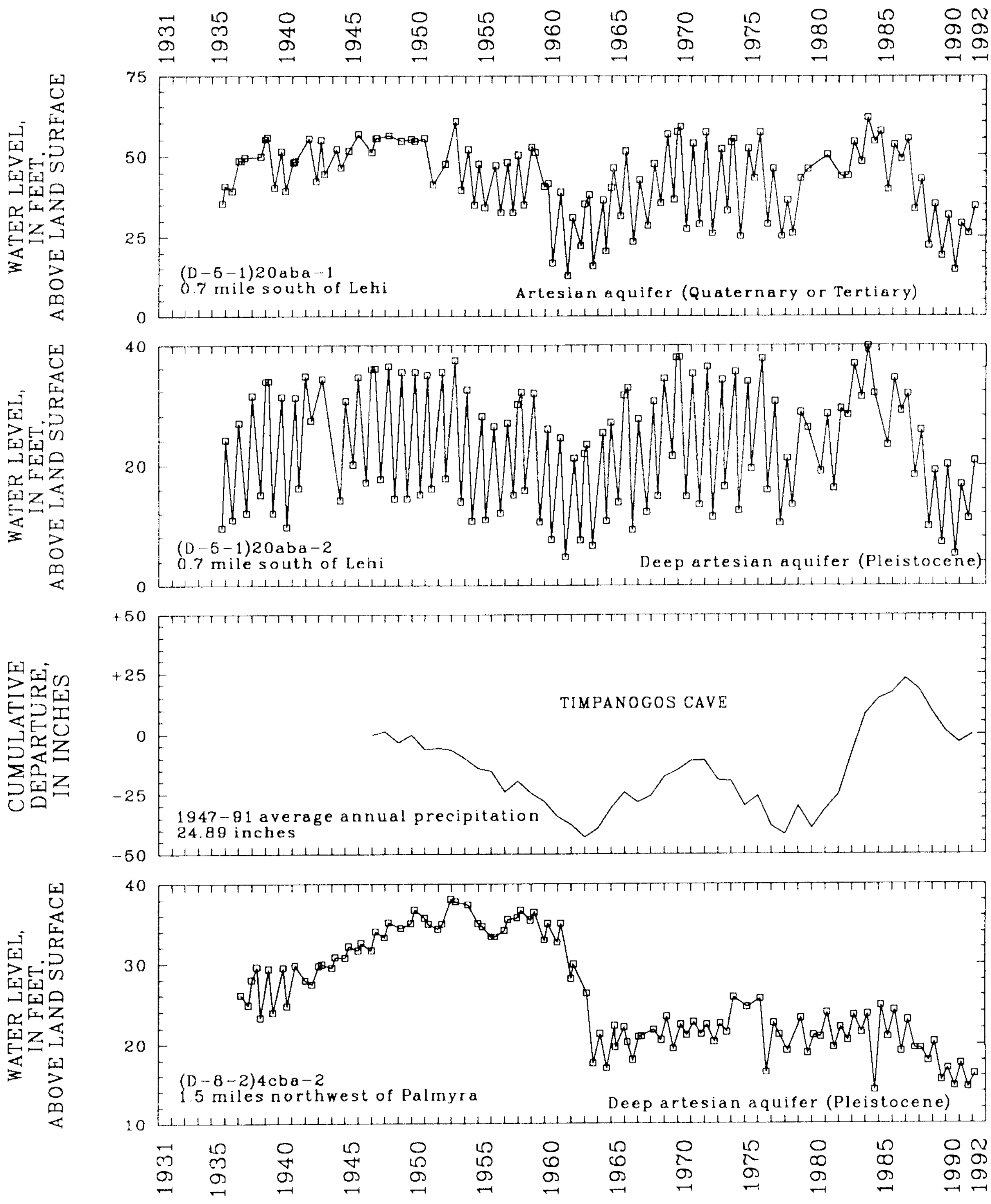


Figure 18.--Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to annual withdrawals for public supply, to total annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

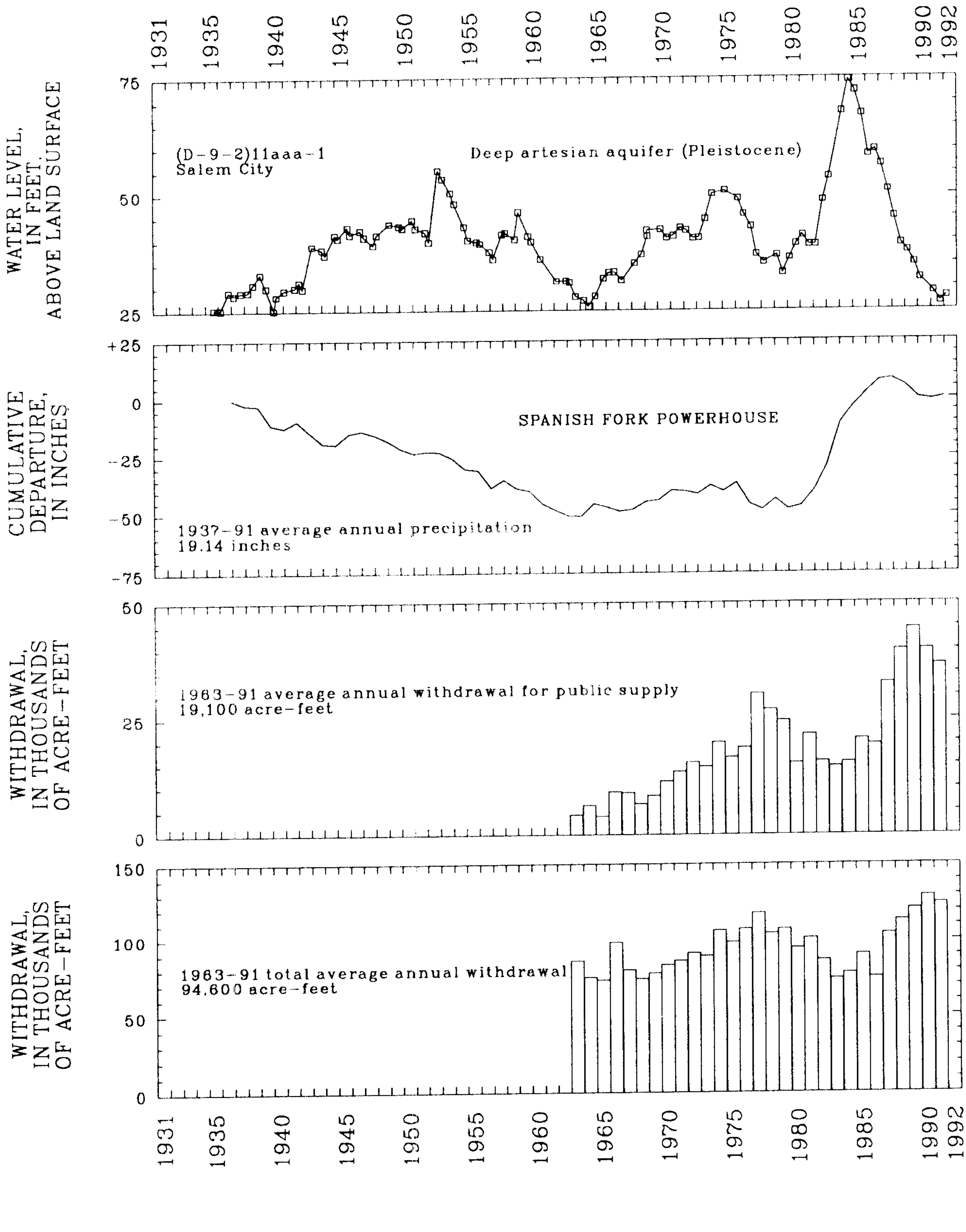


Figure 18.--Continued

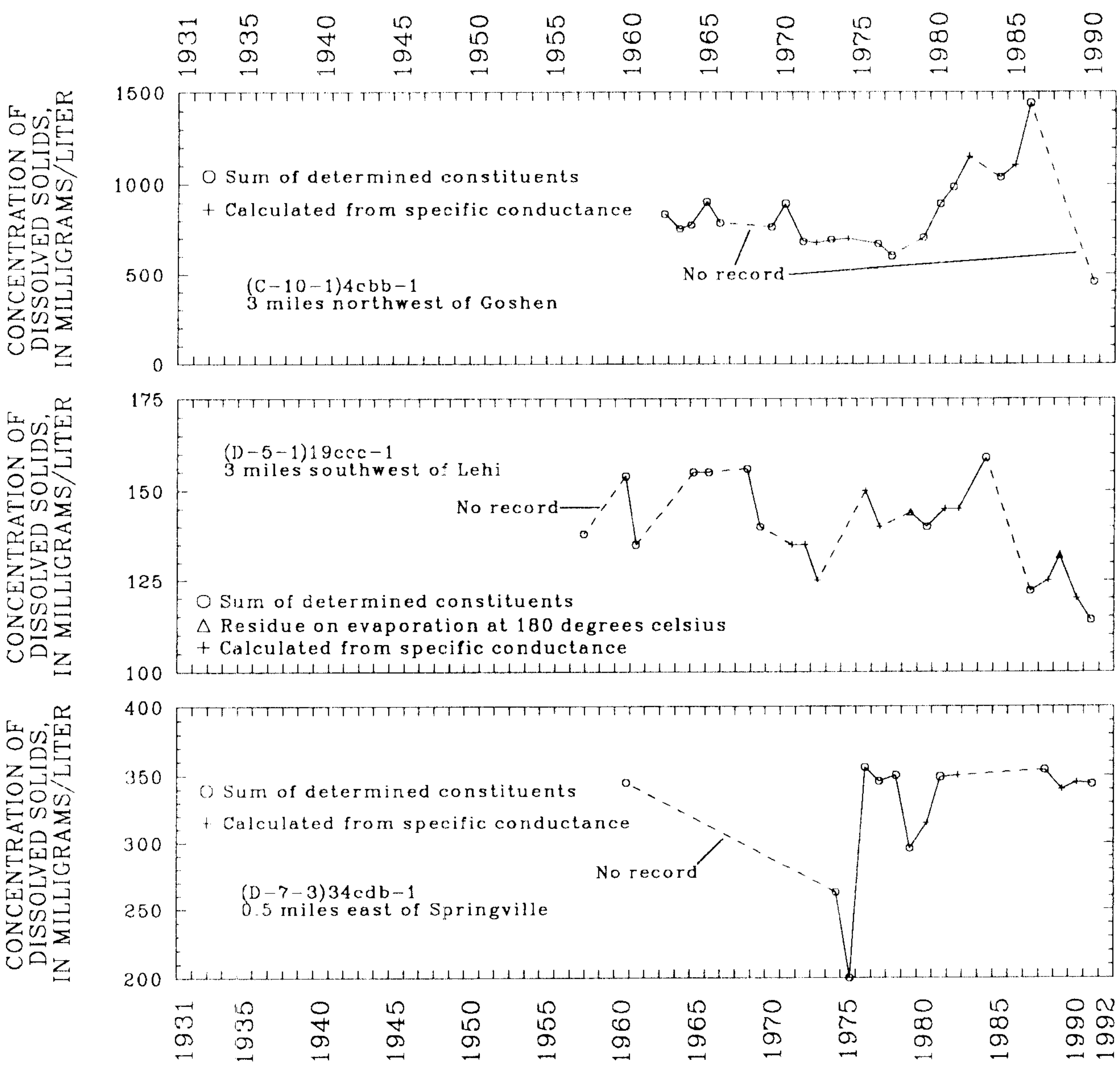


Figure 18.—Continued

JUAB VALLEY

by R. B. Garrett

Withdrawal of water from wells in Juab Valley during 1991 was about 25,000 acre-feet (table 2). This is 2,000 acre-feet less than was reported for 1990 and 8,000 acre-feet more than the average annual withdrawal for 1981-90 (table 3). The average annual withdrawal for the 1987-91 period, 25,000 acre-feet, was 15,000 acre-feet more than for the preceding five-year period, 1982-86 (table 2), mainly due to increased withdrawals for irrigation. The increased withdrawals from wells are the result of less available surface water because of lower precipitation in the 1987-91 period than during the preceding five years (1982-86). The 1987-91 average annual precipitation at Nephi was 13.14 inches, which is 6.77 inches less than the average for the preceding five-year period, 1982-86.

Water levels generally declined from March 1987 to March 1992 in Juab Valley. Declines of as much as 37 feet occurred in the irrigated areas near Nephi; however, the largest decline, nearly 63 feet, was near Levan (fig. 19). The decline in water levels is related to increased withdrawals during the 1987-91 period compared with the preceding five-year period, 1982-86, and less recharge resulting from less precipitation for the 1987-91 period compared with the 1982-86 period. Water levels rose less than 4 feet in a small area west of Levan Ridge.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to the concentration of dissolved solids in water from well (D-13-1)7dbc-1 is shown in figure 20. Precipitation at Nephi during 1991 was 12.81 inches, which is 1.43 inches less than the average annual precipitation for 1935-91. The concentration of dissolved solids in water from well (D-13-1)7bdc-1 fluctuated during 1964-91, but generally increased.

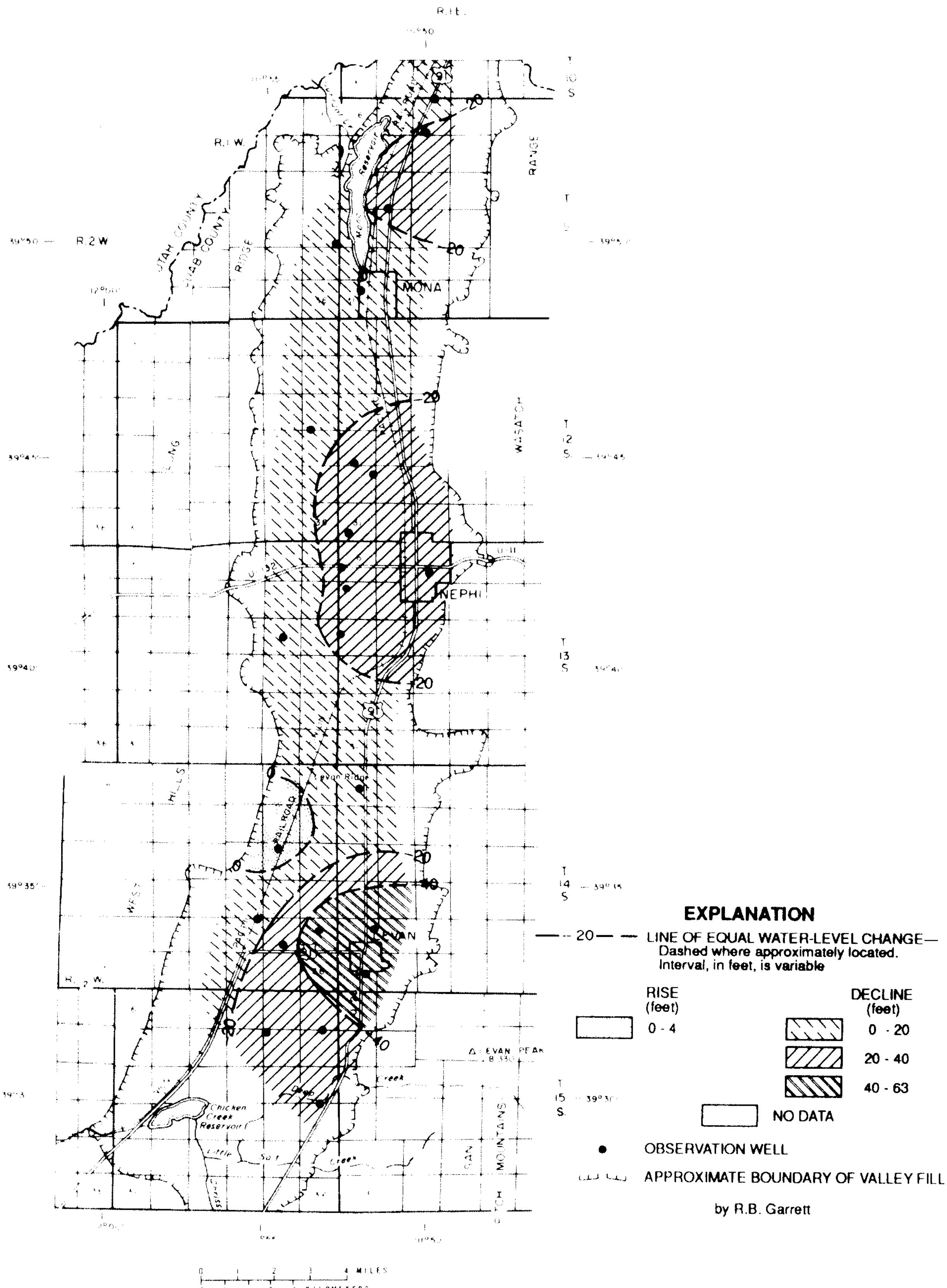


Figure 19.–Map of Juab Valley showing change of water levels from March 1987 to March 1992.

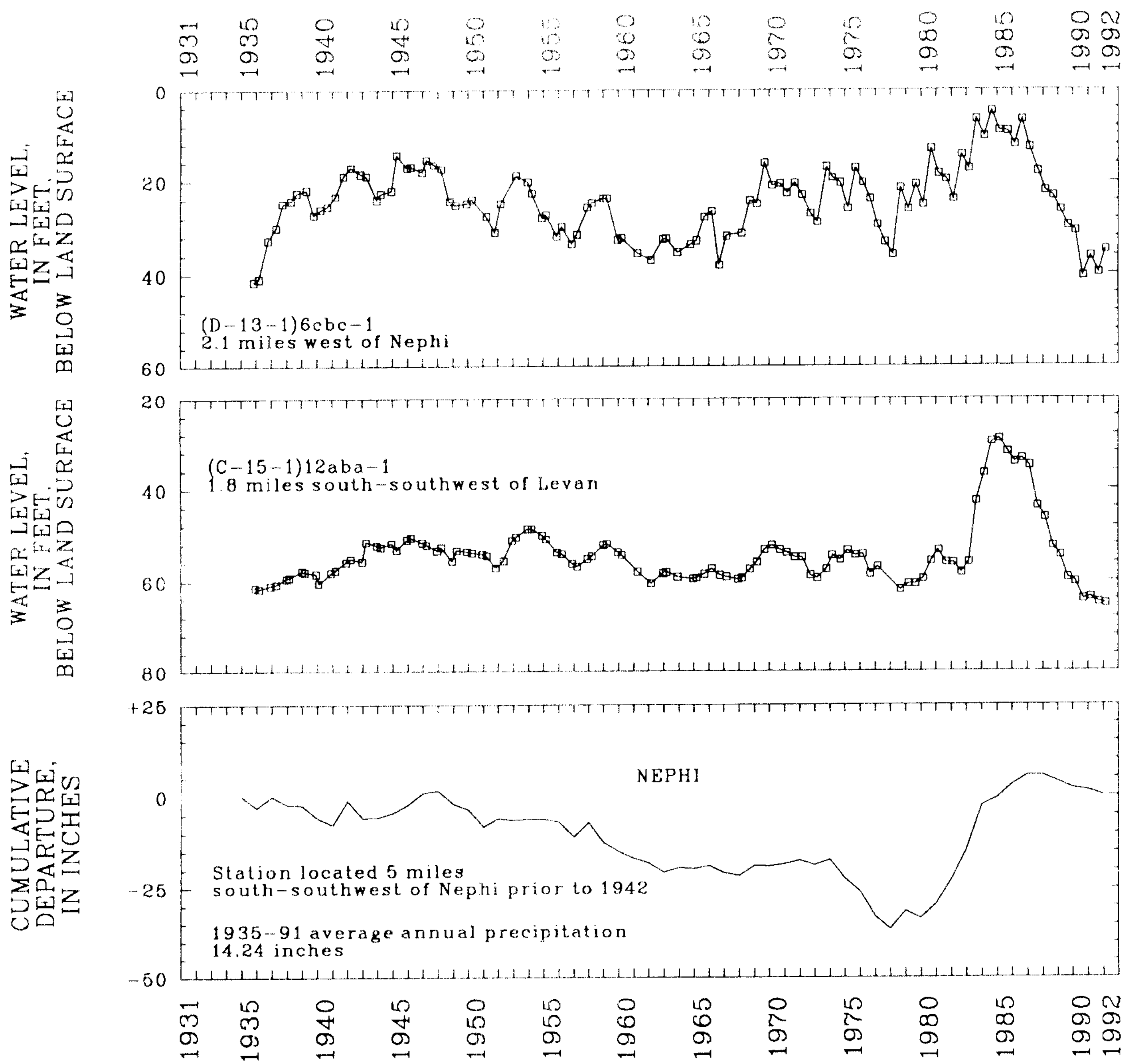


Figure 20.--Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells and to concentration of dissolved solids in water from well (D-13-1)7dbc-1.

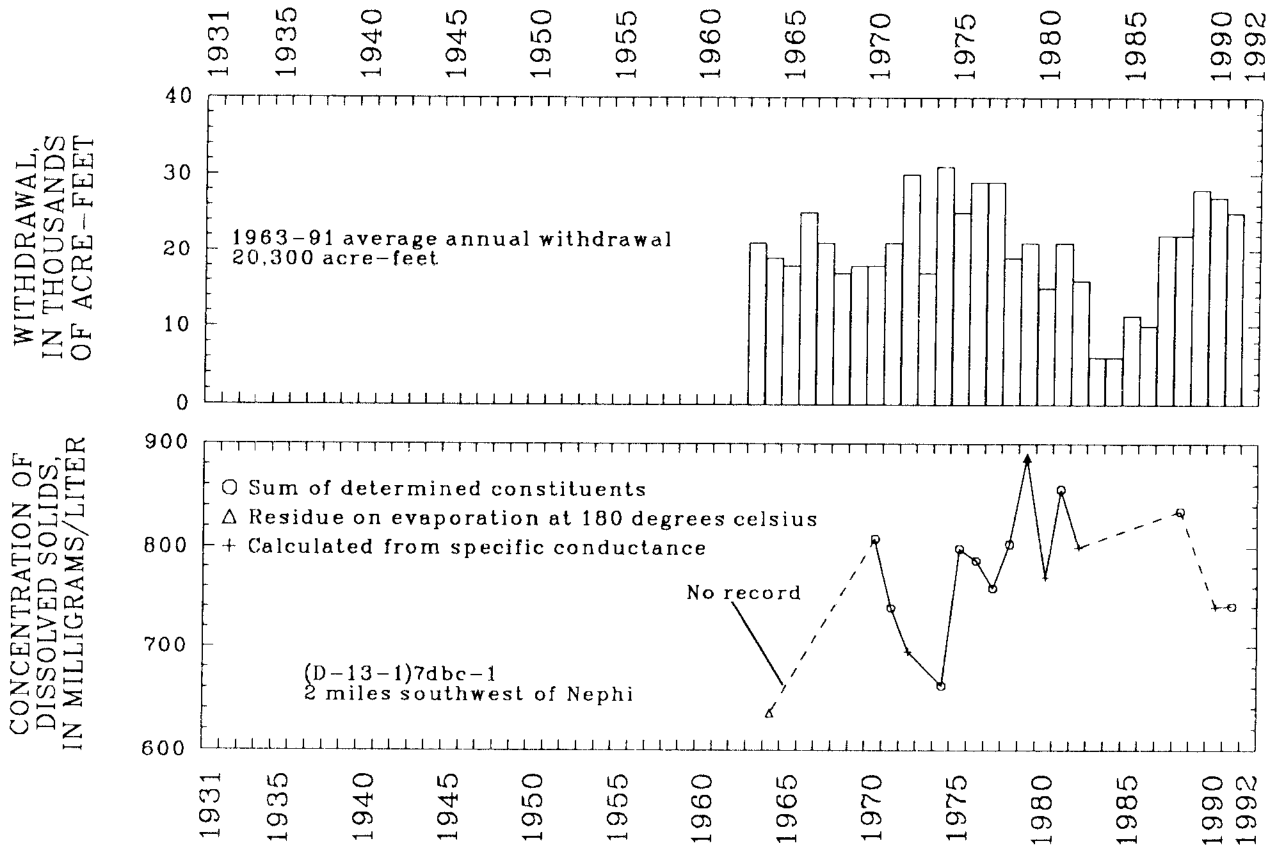


Figure 20.--Continued

SEVIER DESERT

by S. J. Gerner

Withdrawal of water from wells in the Sevier Desert in 1991 was about 34,000 acre-feet. This is the same as reported for 1990 and about 18,000 acre-feet more than the 1981-90 average annual withdrawal (tables 2 and 3). The average annual withdrawal during 1987-91 was 23,000 acre-feet, 11,000 acre-feet more than the average for the preceding five-year period, 1982-86.

Water levels in the shallow artesian aquifer in the Sevier Desert generally declined from March 1987 to March 1992. Water levels rose less than one foot in small areas near the Desert and Drum Mountains (fig. 21). Water levels in the deep artesian aquifer also generally declined from March 1987 to March 1992. The largest decline, almost 32 feet, was near Oak City. The declines generally are smaller toward the west and southwest. Although water levels rose southwest of Deseret, the increase was less than 1 foot (fig. 22). Declines in water levels in both aquifers are probably the result of increased withdrawals during 1987-91, as compared to the preceding five-year period, and to decreased recharge resulting from less precipitation and less streamflow during 1987-91, as compared with the preceding five-year period.

The relation of water levels in selected wells to discharge of the Sevier River near Juab, to precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1 is shown in figure 23. Precipitation at Oak City was 10.70 inches in 1991, 2.04 inches less than the 1935-91 average annual precipitation. Average annual precipitation for the five-year period 1987-91 was 11.27 inches, 5.97 inches less than during the preceding five-year period, 1982-86. Discharge of the Sevier River during 1991 was about 105,400 acre-feet, 5,700 acre-feet less than in 1990 and 79,000 acre-feet less than the long-term average (1935-91). Average flow of the Sevier River during 1987-91, approximately 166,000 acre-feet, was about 431,300 acre-feet less than during the preceding five-year period, 1982-86. The concentration of dissolved solids in water from well (C-15-4)18daa-1, near Lynndyl, has generally increased since 1958 from about 900 milligrams per liter to about 1,800 milligrams per liter. This increase may be a result of recharge from irrigation water from the Sevier River, which contains more dissolved solids than does local ground water.

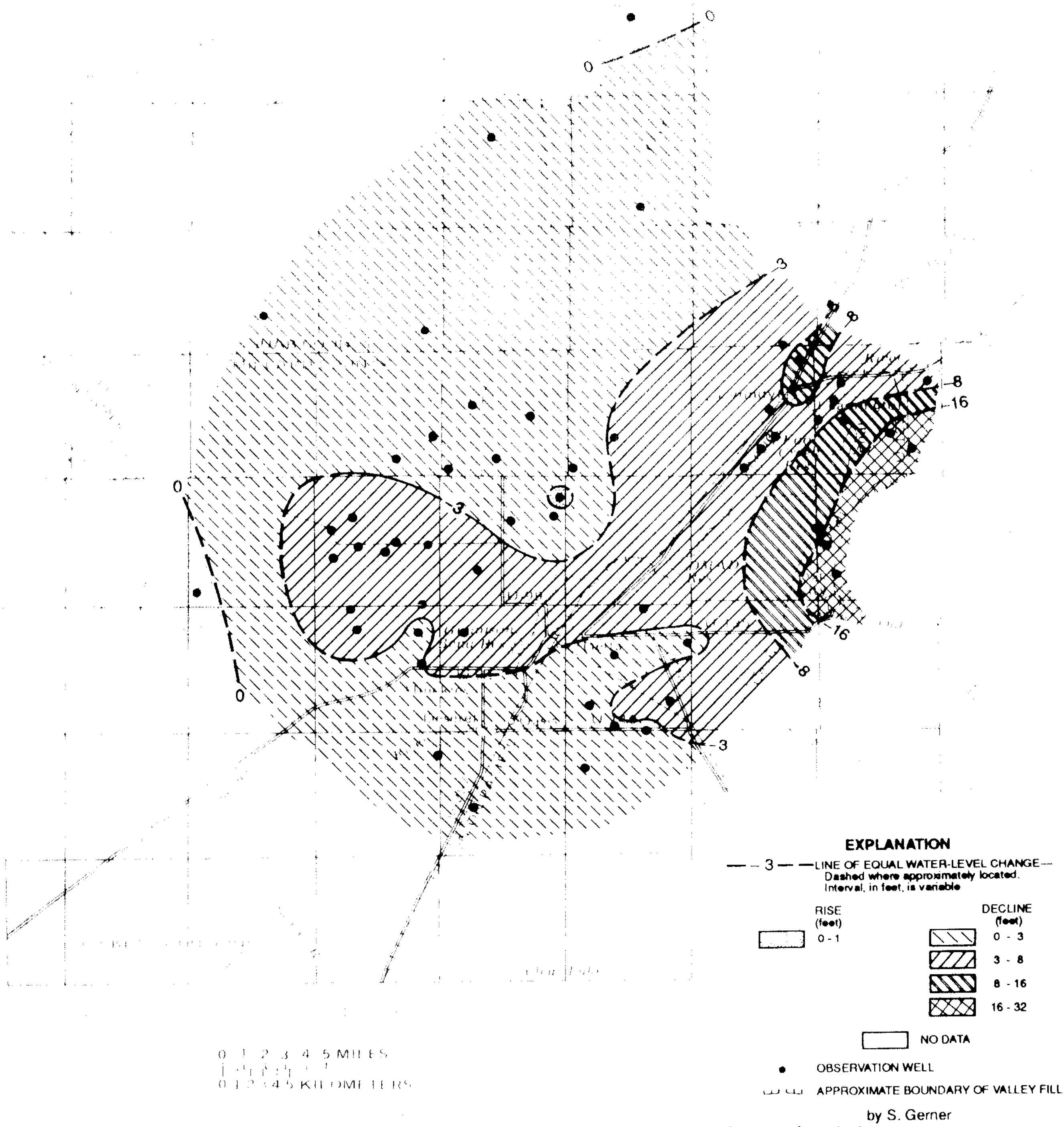


Figure 21.–Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1987 to March 1992.

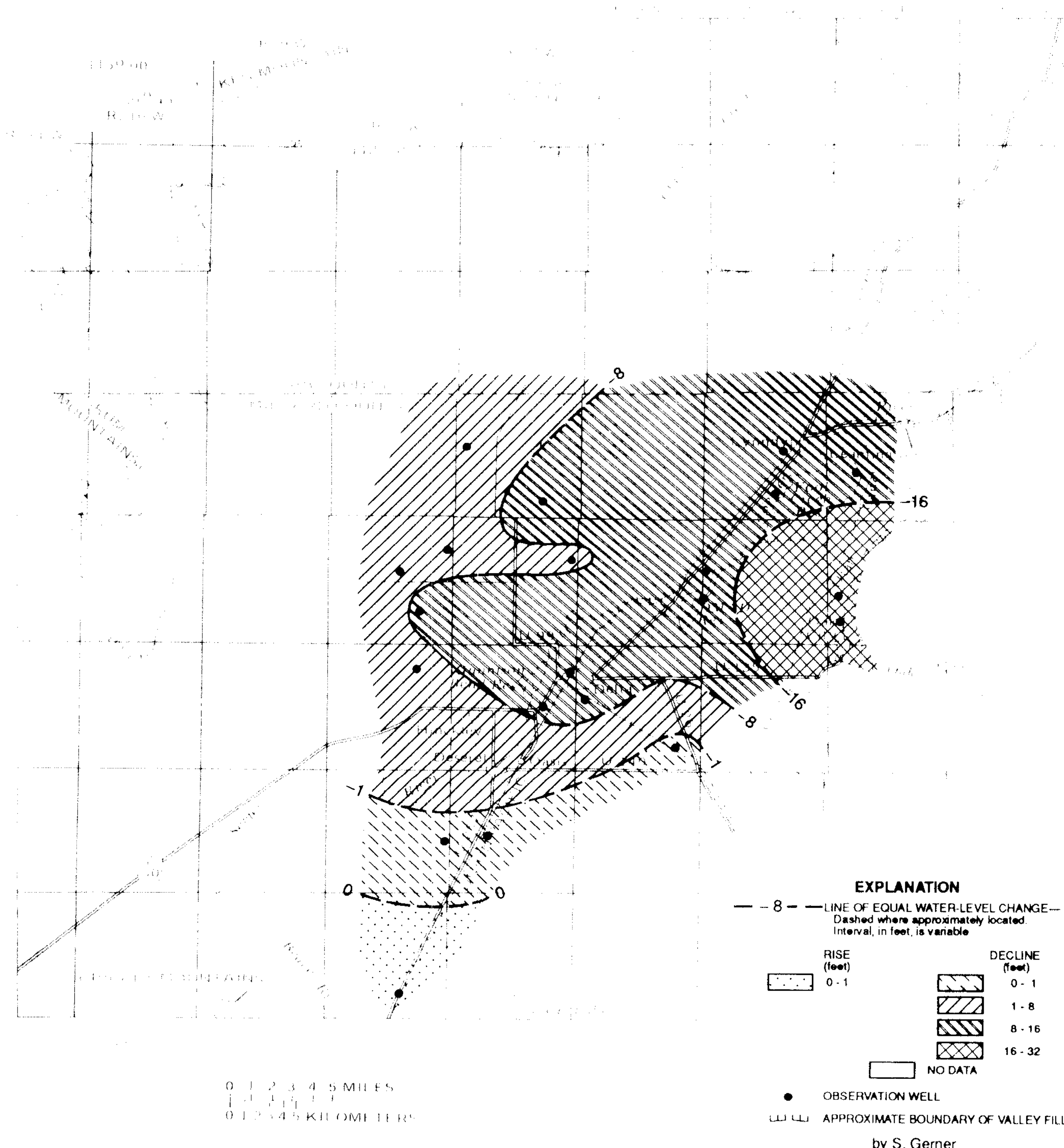


Figure 22.–Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1987 to March 1992.

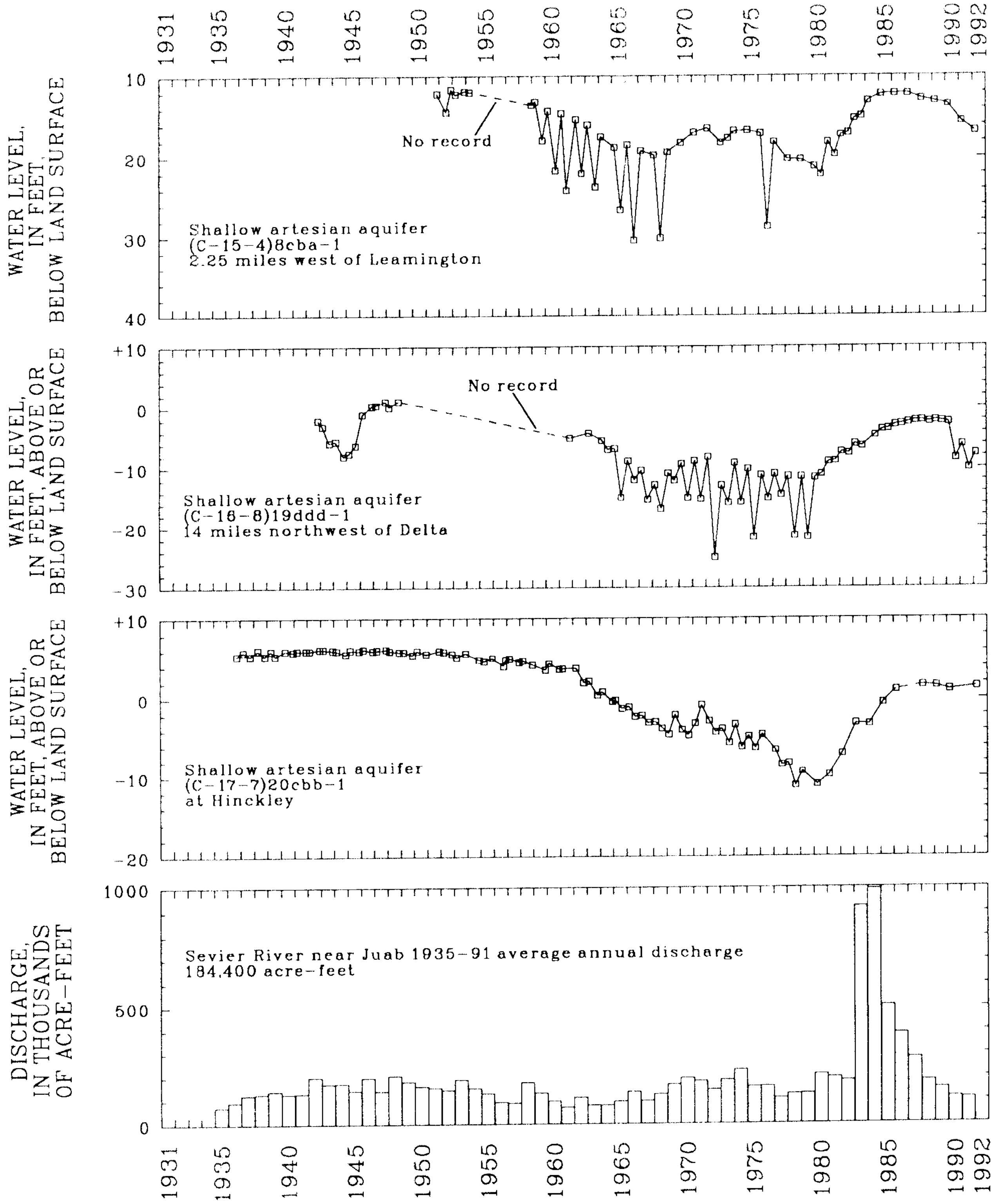


Figure 23.--Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1.

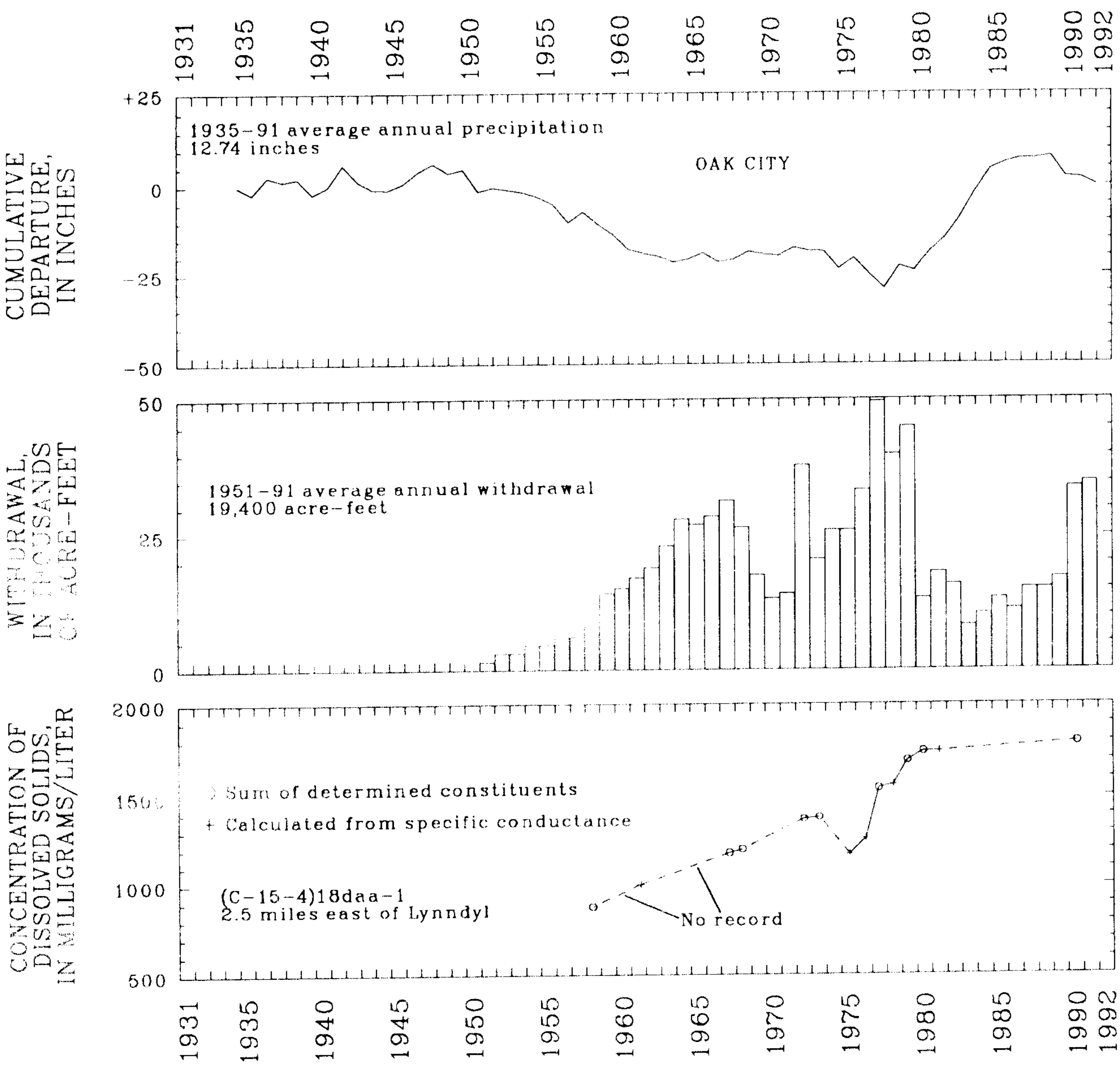


Figure 23.--Continued

CENTRAL SEVIER VALLEY

by B. A. Slaugh

Withdrawal of water from wells in the central Sevier Valley in 1991 was about 18,000 acre-feet (table 2). This is the same as the 1990 withdrawal, the ten-year average for 1981-90, and the five-year averages for 1982-86 and 1987-91 (tables 2 and 3).

Water levels declined in most of the central Sevier Valley from March 1987 to March 1992 (fig. 24). The largest decline, about 21 feet, occurred south of Monroe. The decline in water levels probably is due mostly to less precipitation and streamflow, resulting in less recharge during 1987-91 than during the preceding five-year period, 1982-86. Water levels rose as much as 3 feet in areas east of Richfield, and north of Salina.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Salina, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 25. Discharge of the Sevier River at Hatch in 1991 was about 42,100 acre-feet, approximately 36,200 acre-feet less than the 1940-91 annual average discharge. The average annual discharge during 1987-91 was about 54,900 acre-feet, approximately 56,400 acre-feet per year less than the 1982-86 annual average. Precipitation at Salina was 9.34 inches in 1991, which was only 0.63 inches less than the 1935-91 average annual precipitation. The average annual precipitation for 1987-91 was 8.30 inches, which was 2.93 inches less than the average for the preceding five-year period, 1982-86. The concentration of dissolved solids in water from well (C-23-2)15dcb-4 has ranged from 330 milligrams per liter to more than 600 milligrams per liter with no apparent long-term trend.

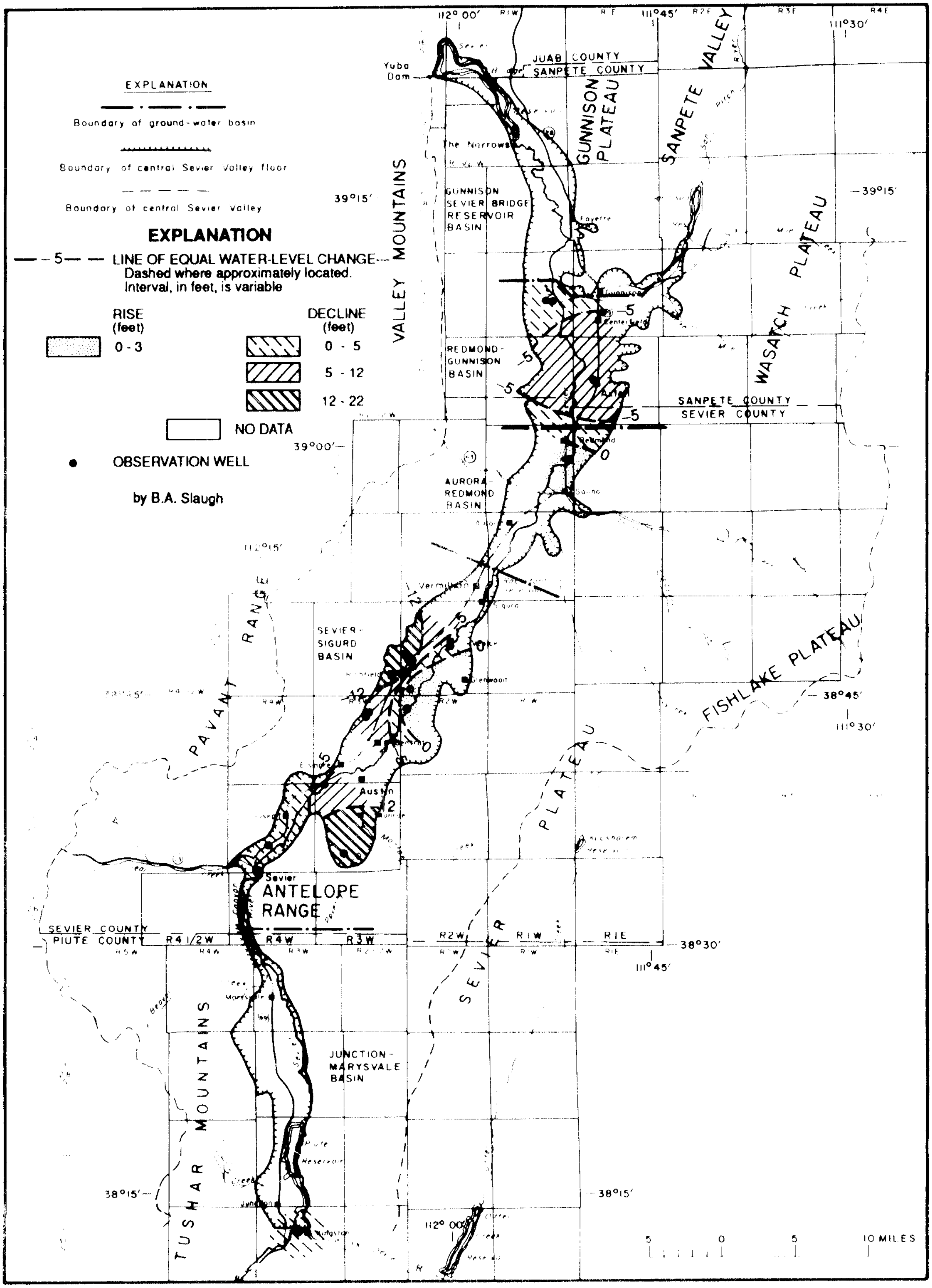


Figure 24.–Map of the central Sevier Valley showing change of water levels from March 1987 to March 1992.

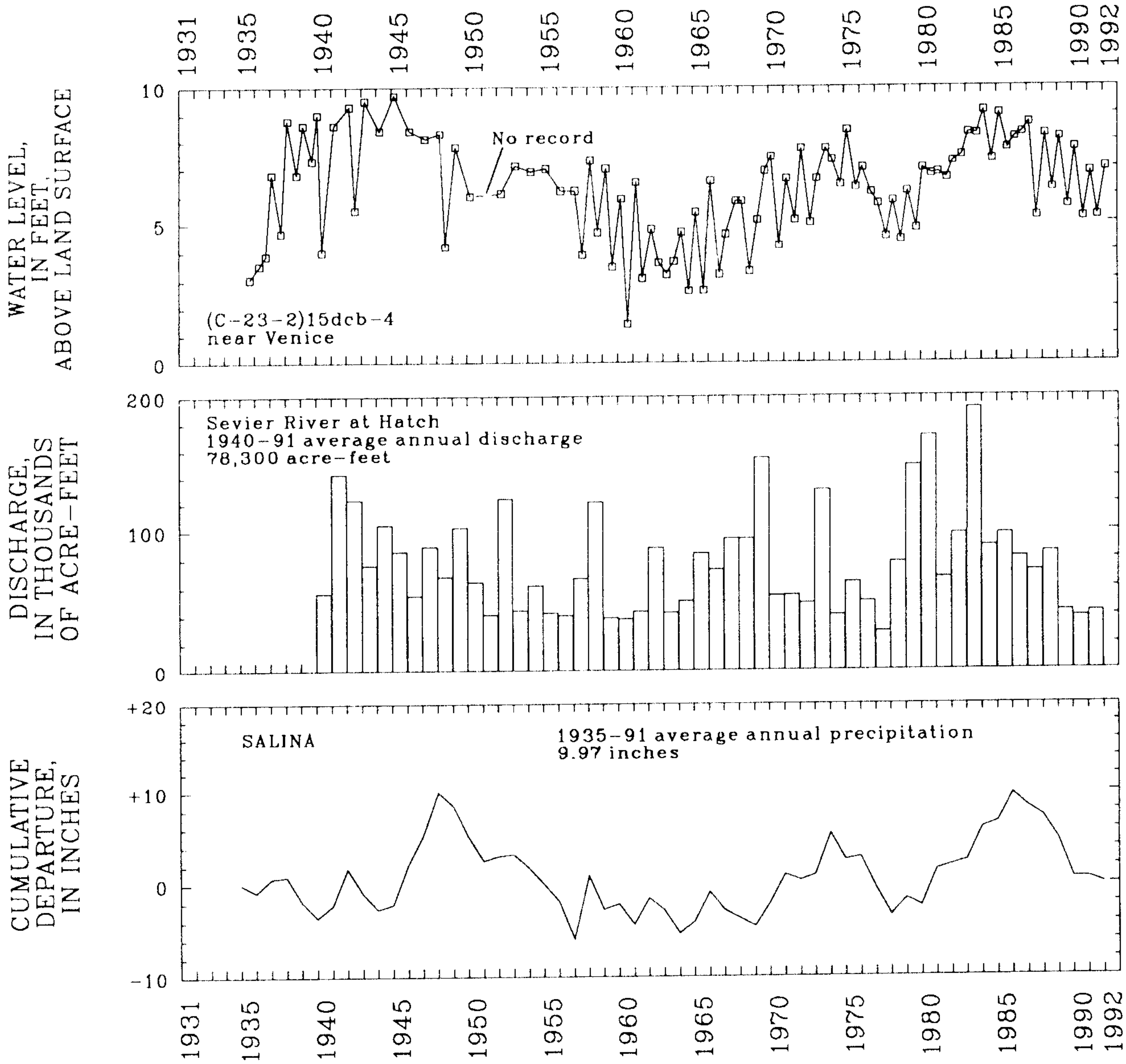


Figure 25.--Relation of water levels in selected wells in central Sevier Valley to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Salina, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

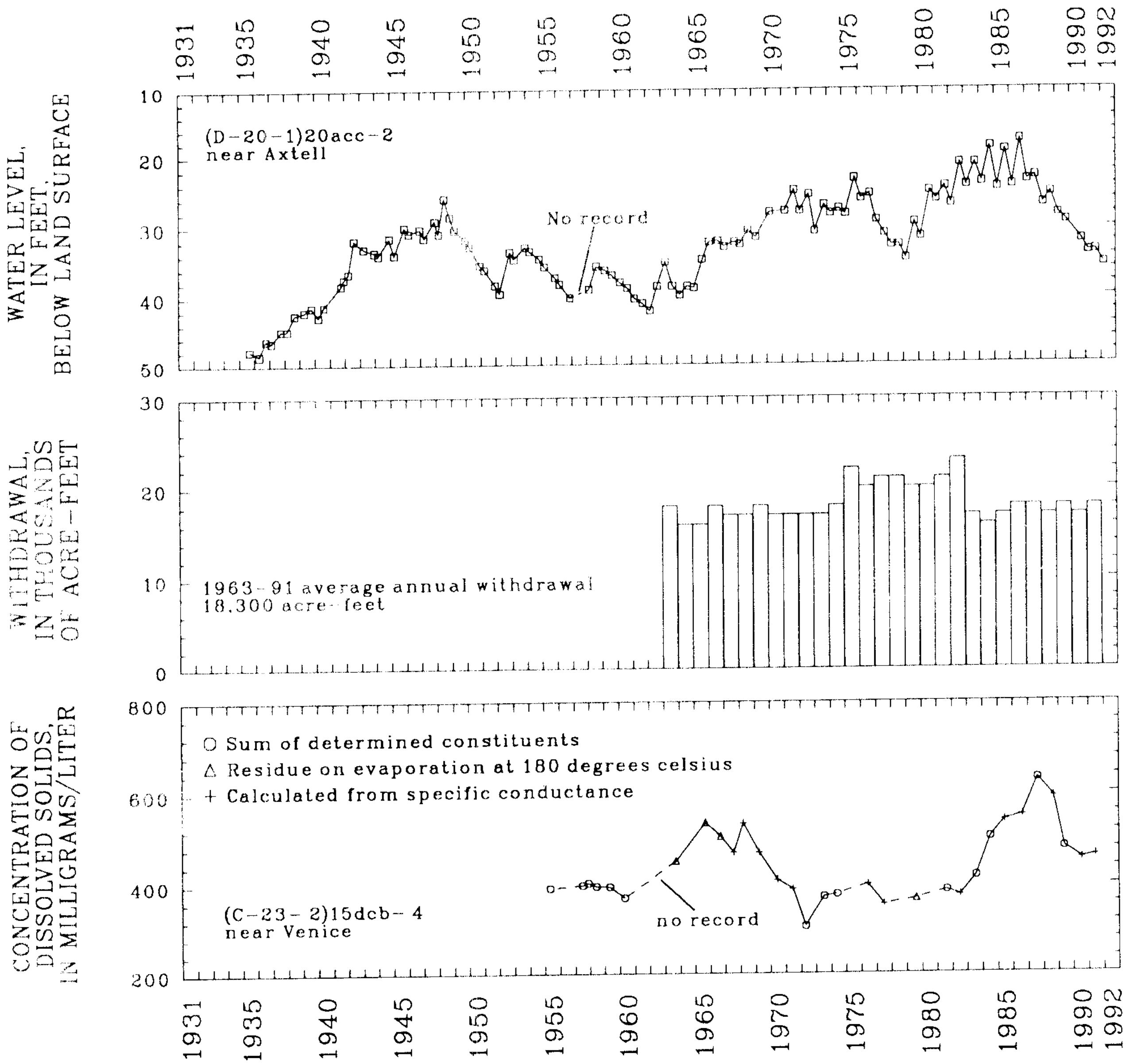


Figure 25.--Continued

PAHVANT VALLEY

by R. L. Swenson

Withdrawal of water from wells in Pahvant Valley in 1991 was about 74,000 acre-feet. This was 14,000 acre-feet less than was reported for 1990, but 7,000 acre-feet more than the average annual withdrawal for 1981-90 (table 2 and 3). The decrease in withdrawals from 1990 to 1991 was mainly due to a decrease in withdrawals for irrigation, much of which probably was reduced discharge from flowing wells as a result of water-level declines. Withdrawals have generally increased over the last ten years from an annual average of 55,000 acre-feet during 1982-86 to an annual average of 76,000 acre-feet during 1987-91.

Water levels declined in most of Pahvant Valley from March 1987 to March 1992 (fig. 26). The maximum observed decline of about 55 feet occurred west of Holden. Declines in water levels probably resulted from increased withdrawals during the five-year period 1987-91 as compared with the preceding five-year period, 1982-86, and to decreased recharge due to less precipitation during 1987-91 as compared with 1982-86.

Water-level rises in scattered areas in the valley probably resulted from local decreases in withdrawals. The largest observed rise, about 13 feet, occurred southwest of Kanosh.

The relation of water levels in selected observation wells to precipitation at Fillmore and to annual withdrawals from wells is shown in figure 27. Precipitation at Fillmore in 1991 was 14.00 inches, which is 0.95 inches less than the 1931-91 average annual precipitation. The average annual precipitation during 1987-91, 13.87 inches, was 6.90 inches less than the annual average for 1982-86.

The concentration of dissolved solids in water from wells near Flowell and west of Kanosh are shown in figure 28. Water from both wells shows a general increase in concentration since the 1950's, although the lower concentrations in water from both wells since the late 1970's may be related to increased recharge associated with much greater-than-average precipitation during 1980-85. The increase in recharge (as well as small average withdrawals from wells during 1983-86), is indicated by general rises in water levels in all observation wells during 1982-86.

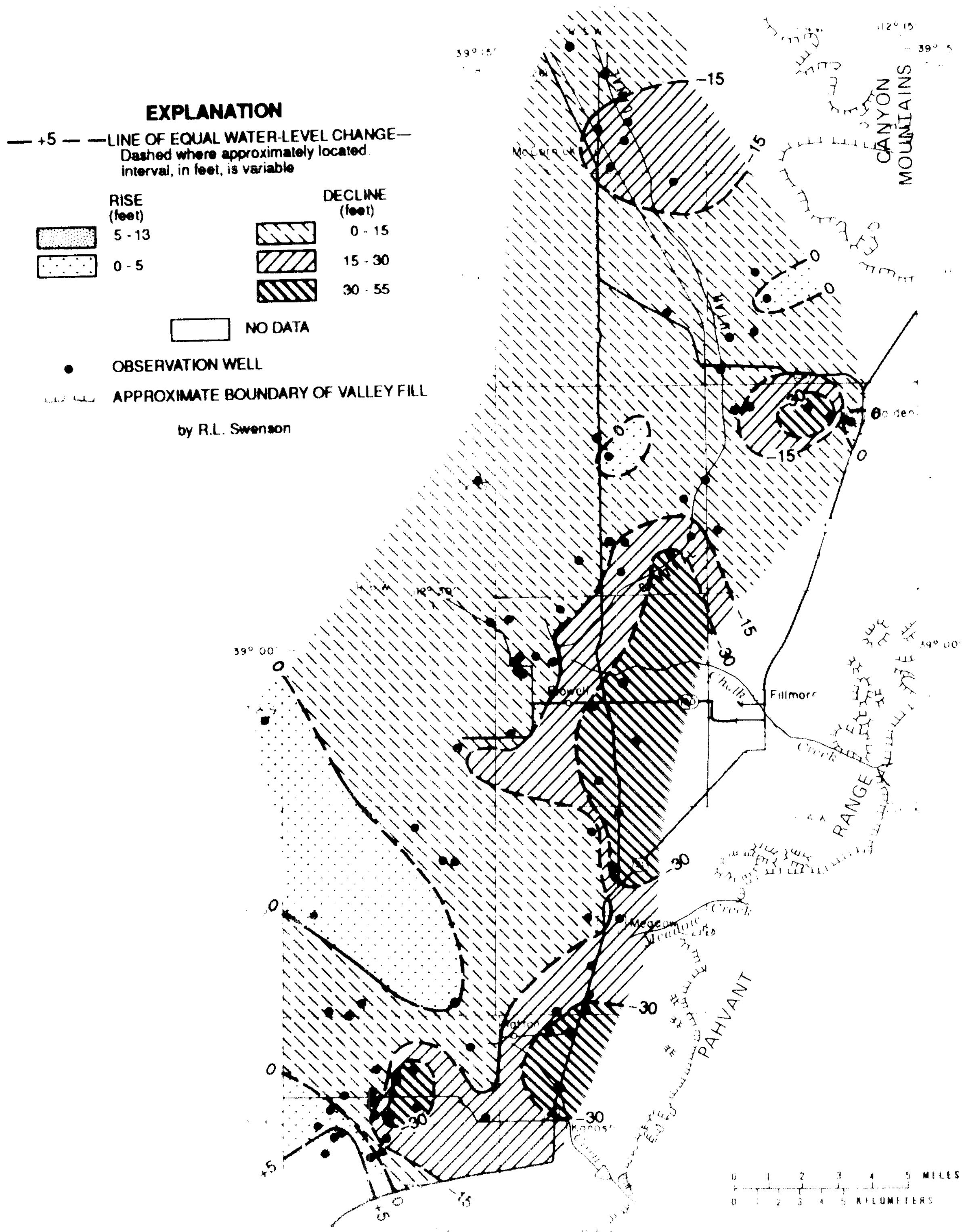


Figure 26.–Map of Pahvant Valley showing change of water levels from March 1987 to March 1992.

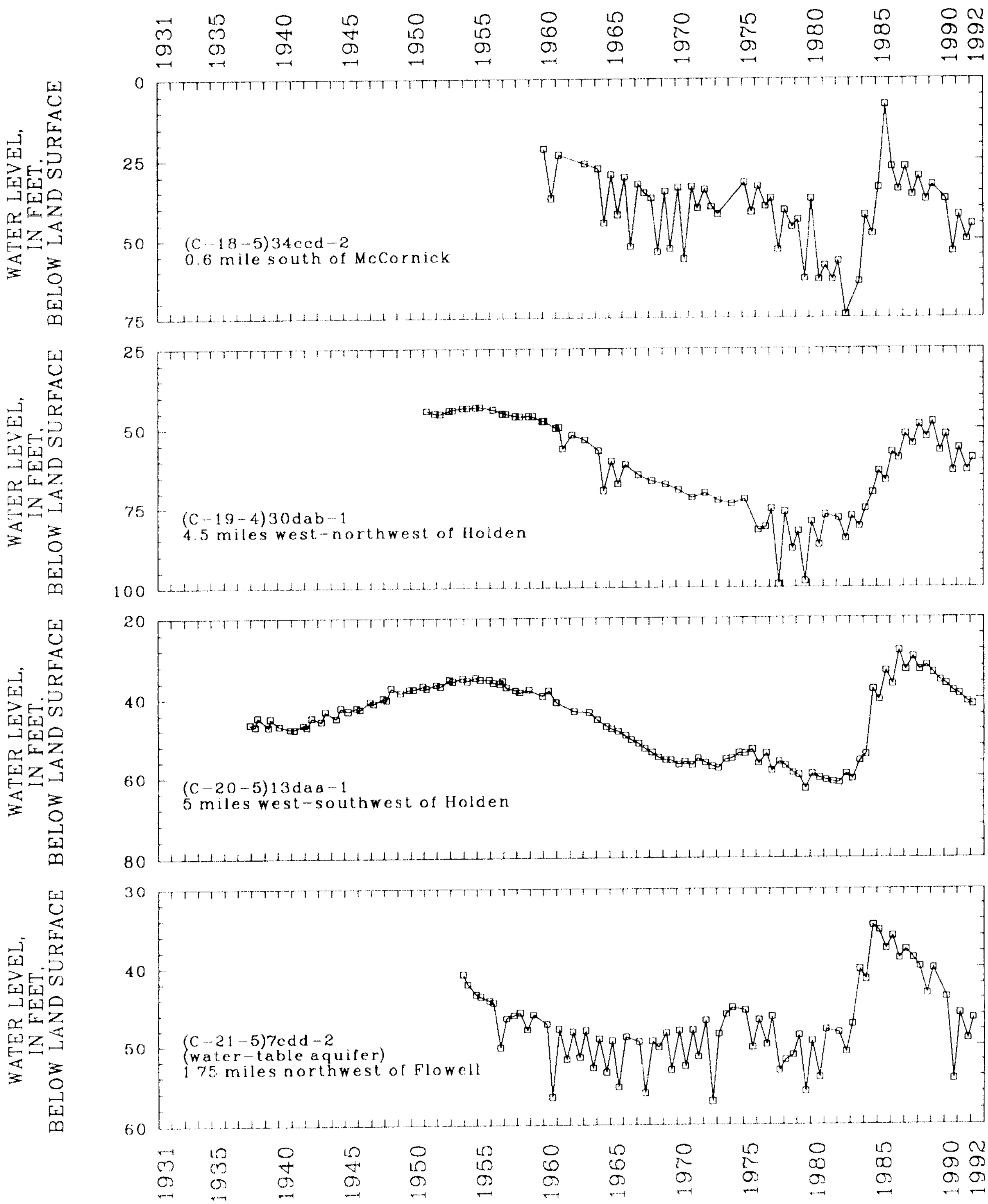


Figure 27.— Relation of water levels in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore and to annual withdrawals from wells

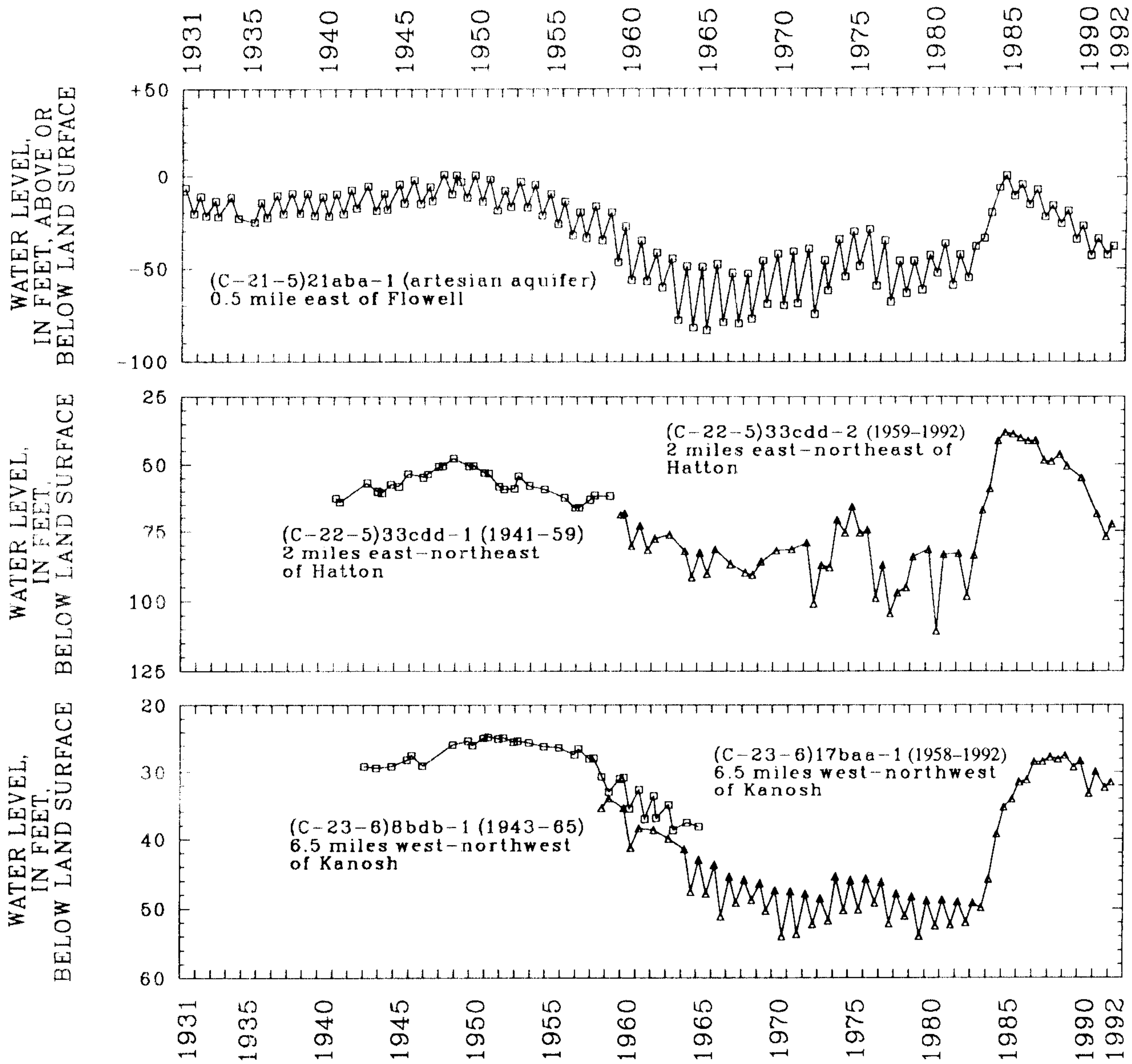


Figure 27.--Continued

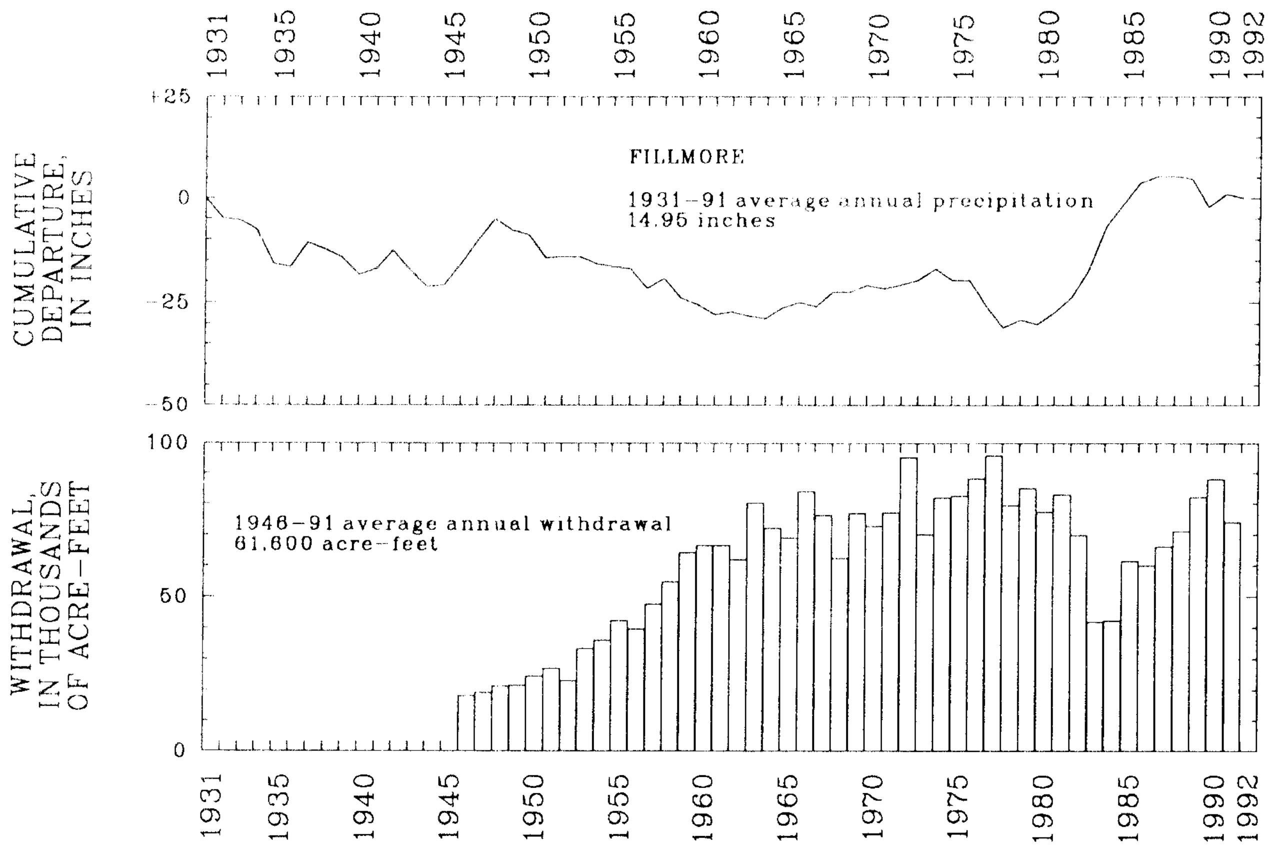


Figure 27.--Continued

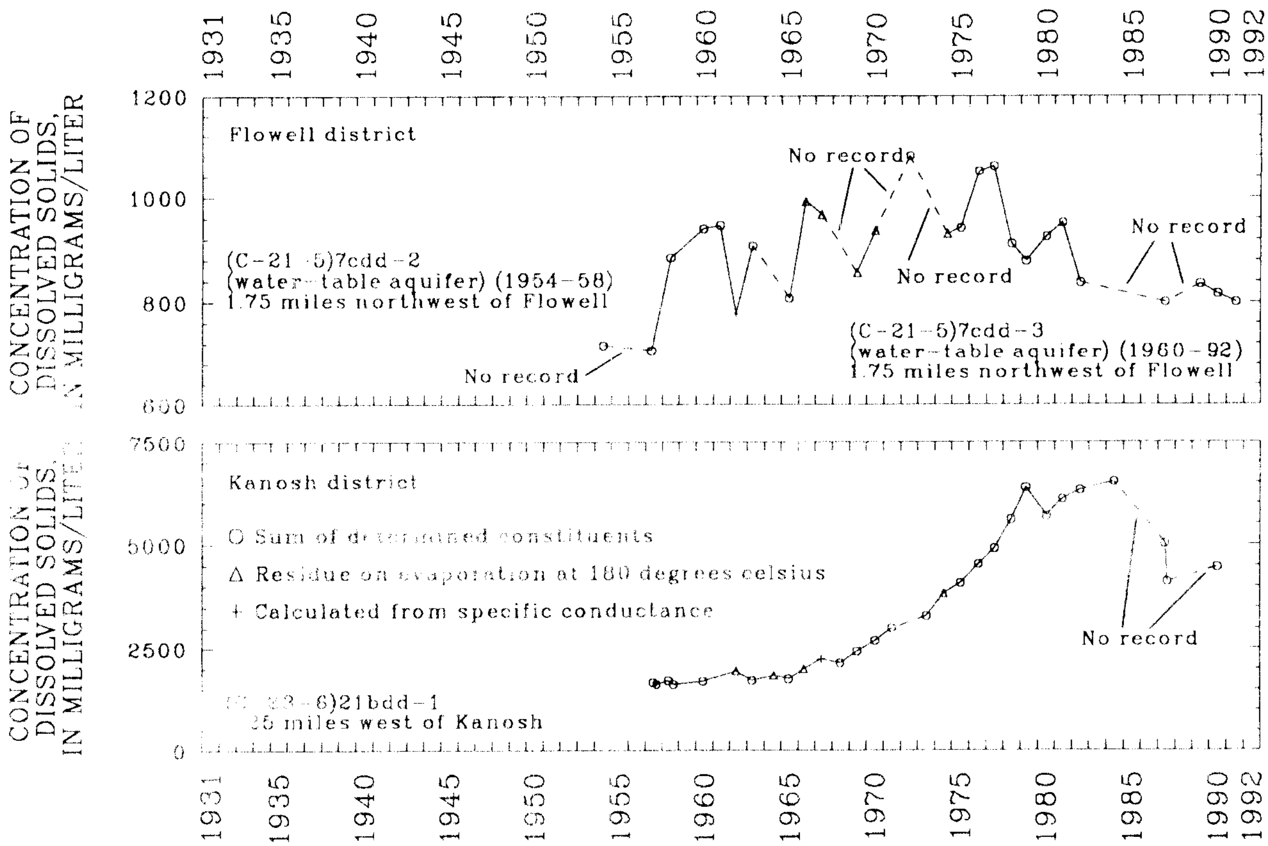


Figure 28.--Concentration of dissolved solids in water from selected wells in Pahvant Valley.

CEDAR VALLEY, IRON COUNTY

by J. H. Howells

Withdrawal of water from wells in Cedar Valley, Iron County, during 1991 was about 34,000 acre-feet, which is 4,000 acre-feet more than was reported for 1990 and 10,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). Average annual withdrawal during 1987-91 was about 27,000 acre-feet, which is 5,000 acre-feet more than during the previous five-year period, 1982-86.

Ground-water levels declined from March 1987 to March 1992 in most of Cedar Valley (fig. 29); although in the northern part of the valley, levels rose as much as 2 feet. The largest decline, almost 26 feet, occurred in an area northwest of Cedar City. The declines are probably due to increased average withdrawals during the 1987-1991 period, compared with the preceding period, 1982-86, and decreased recharge due to less precipitation and streamflow during the 1987-91 period. Discharge of Coal Creek during 1987-91 was about 48 percent of the discharge during 1982-86.

The relation of water levels in wells (C-35-11)33aac-1 and (C-37-12)34abb-1 to precipitation at Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, to annual withdrawal of water from wells in Cedar Valley, and to concentration of dissolved solids in water from well (C-37-12)23acb-2, is shown in figure 30. Precipitation at Cedar City FAA Airport in 1991 was 9.82 inches, which is 1.11 inches less than the revised quantity for 1990 and 0.92 inches less than the average annual precipitation for 1951-91. Average annual precipitation for 1987-91 was 10.50 inches, 3.26 inches less than precipitation in the previous five-year period, 1982-86. Discharge of Coal Creek was about 14,700 acre-feet in 1991, approximately 2,800 acre-feet more than the revised value for 1990, and about 9,000 acre-feet less than the average annual discharge during 1939-91. The average annual discharge of Coal Creek during 1987-91 was about 17,200 acre-feet, approximately 18,670 acre-feet less than the average annual discharge for the previous five-year period, 1982-86. The concentration of dissolved solids in water from well (C-37-12)23acb-2 has decreased to its lowest level since 1974.

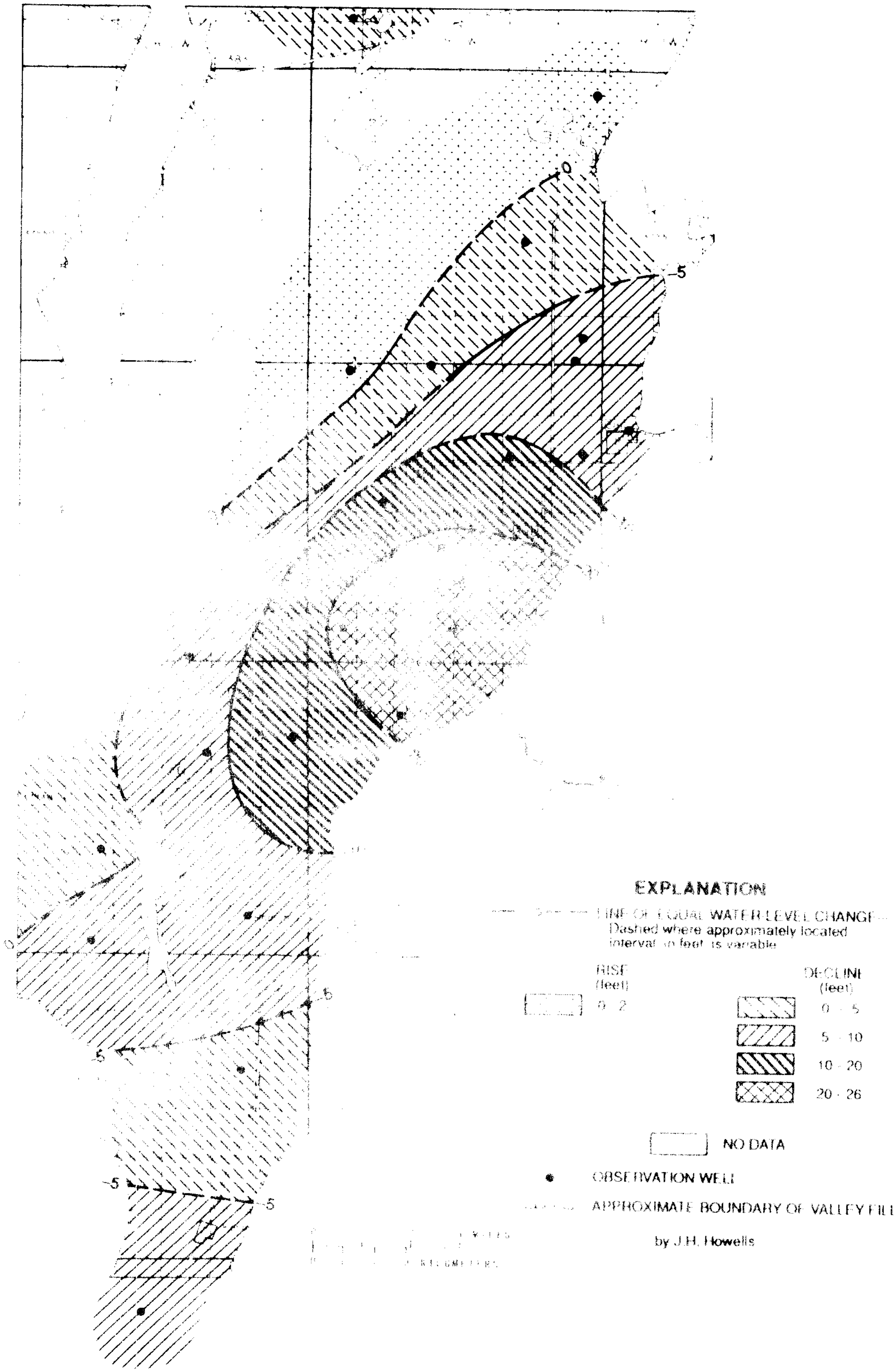


Figure 29.--Map of Cedar Valley, Iron County, showing change of water levels from March 1987 to March 1992.

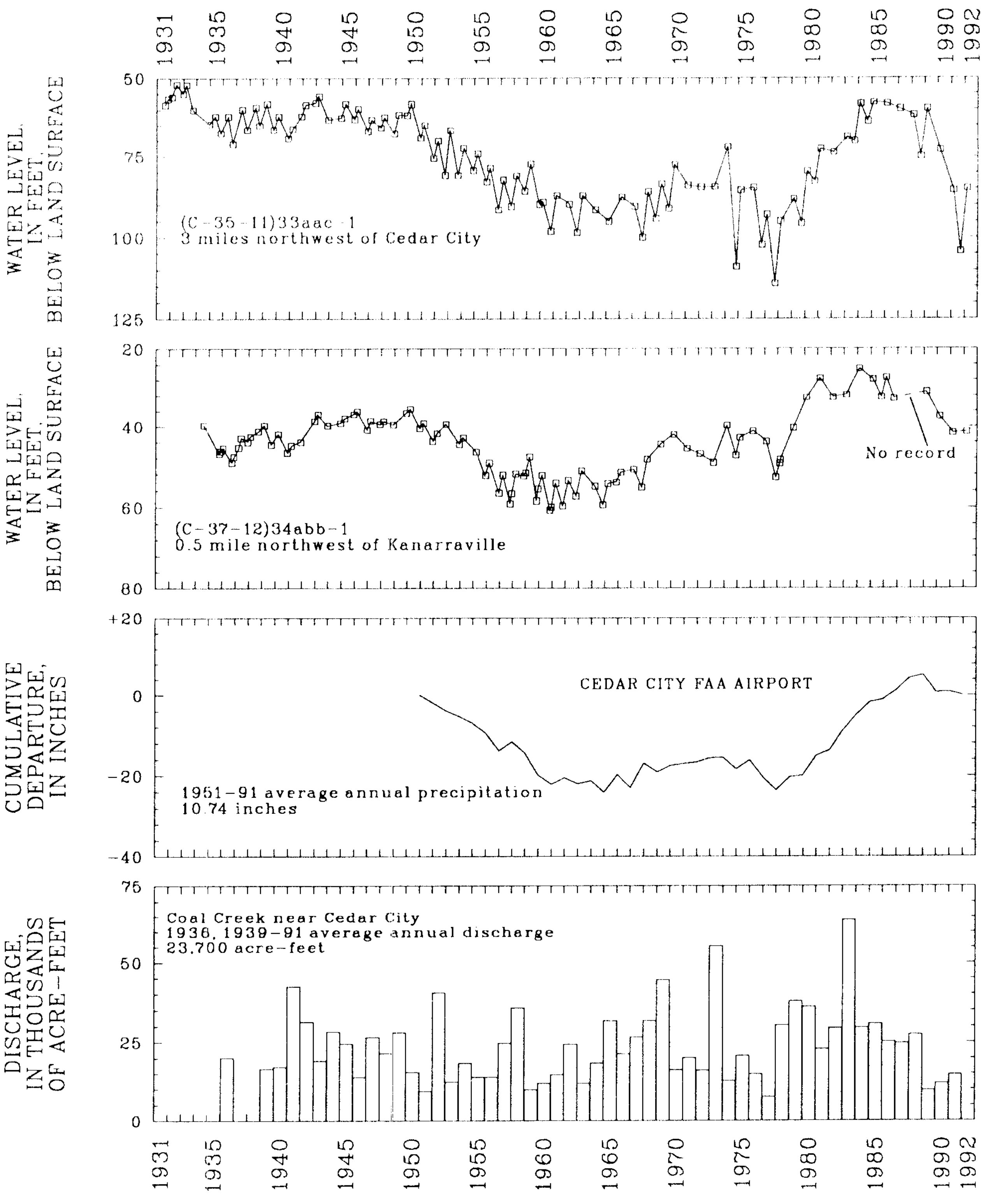


Figure 30.--Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-37-12)23acb-2.

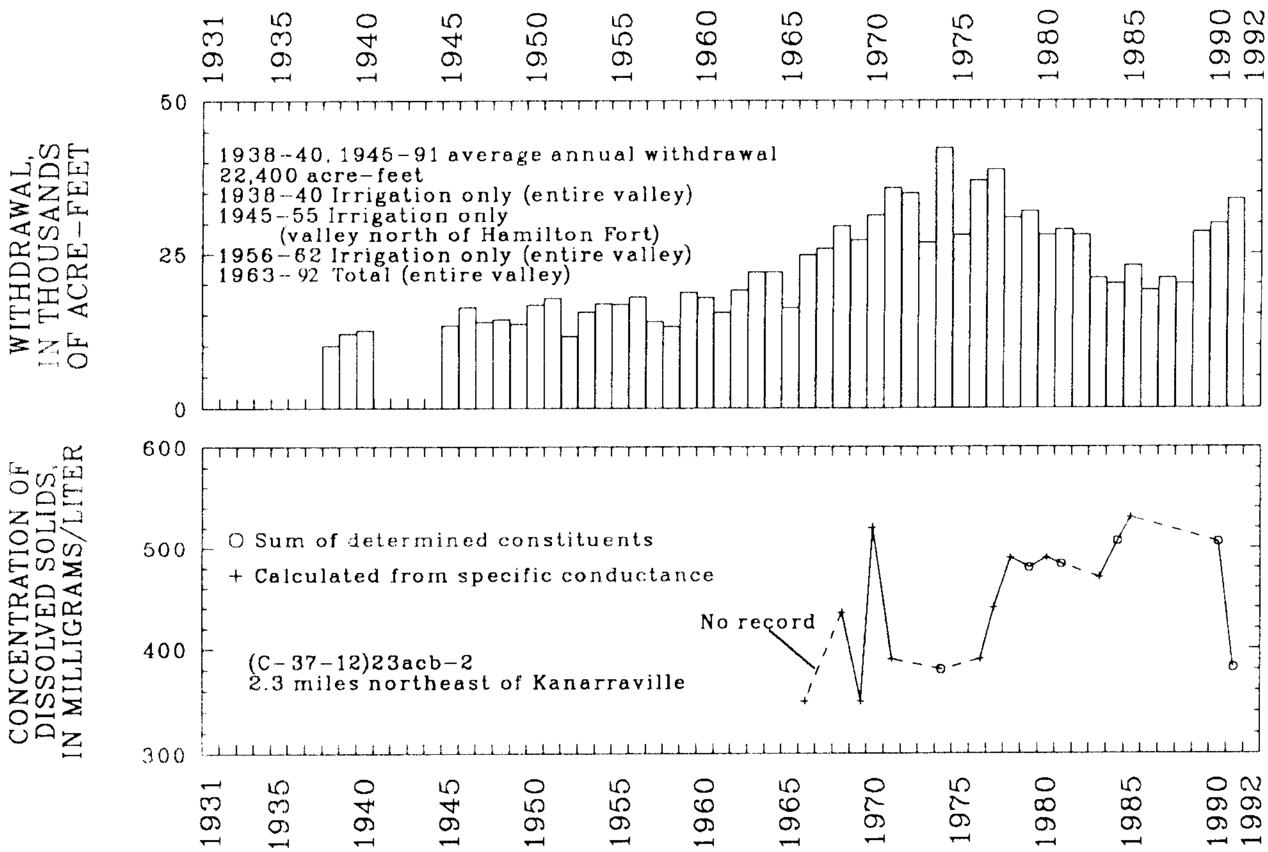


Figure 30.--Continued

PAROWAN VALLEY

by J. H. Howells

Withdrawal of water from wells in Parowan Valley was about 32,000 acre-feet in 1991. This was about 1,000 acre-feet more than in 1990 and 7,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). The average annual withdrawal for 1987-91 was about 27,000 acre-feet, 3,000 acre-feet more than the average annual withdrawal for the preceding five-year period, 1982-86. The increased withdrawal in 1991 as compared with 1990 was due to increased withdrawals for irrigation.

Water levels in wells declined from March 1987 to March 1992 in all parts of Parowan Valley (fig. 31) for which data are available. The largest declines, from 25 to 42 feet, occurred in an area north and west of Parowan and north of Paragonah. The decline in water levels probably is due to increased withdrawals and less recharge because of decreased precipitation during the 1987-91 period as compared with the preceding five-year period, 1982-86.

The relation of water levels in wells (C-34-8)5bca-1 and (C-34-10)24cbc-2 to cumulative departure from average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 32. Precipitation at Parowan Power Plant was 11.87 inches in 1991, 0.50 inches less than average annual precipitation for 1935-91. The average annual precipitation for 1987-91 at Parowan Power Plant was 12.25 inches, 2.52 inches less than average precipitation for the preceding five-year period, 1982-86. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has shown little change since 1976.

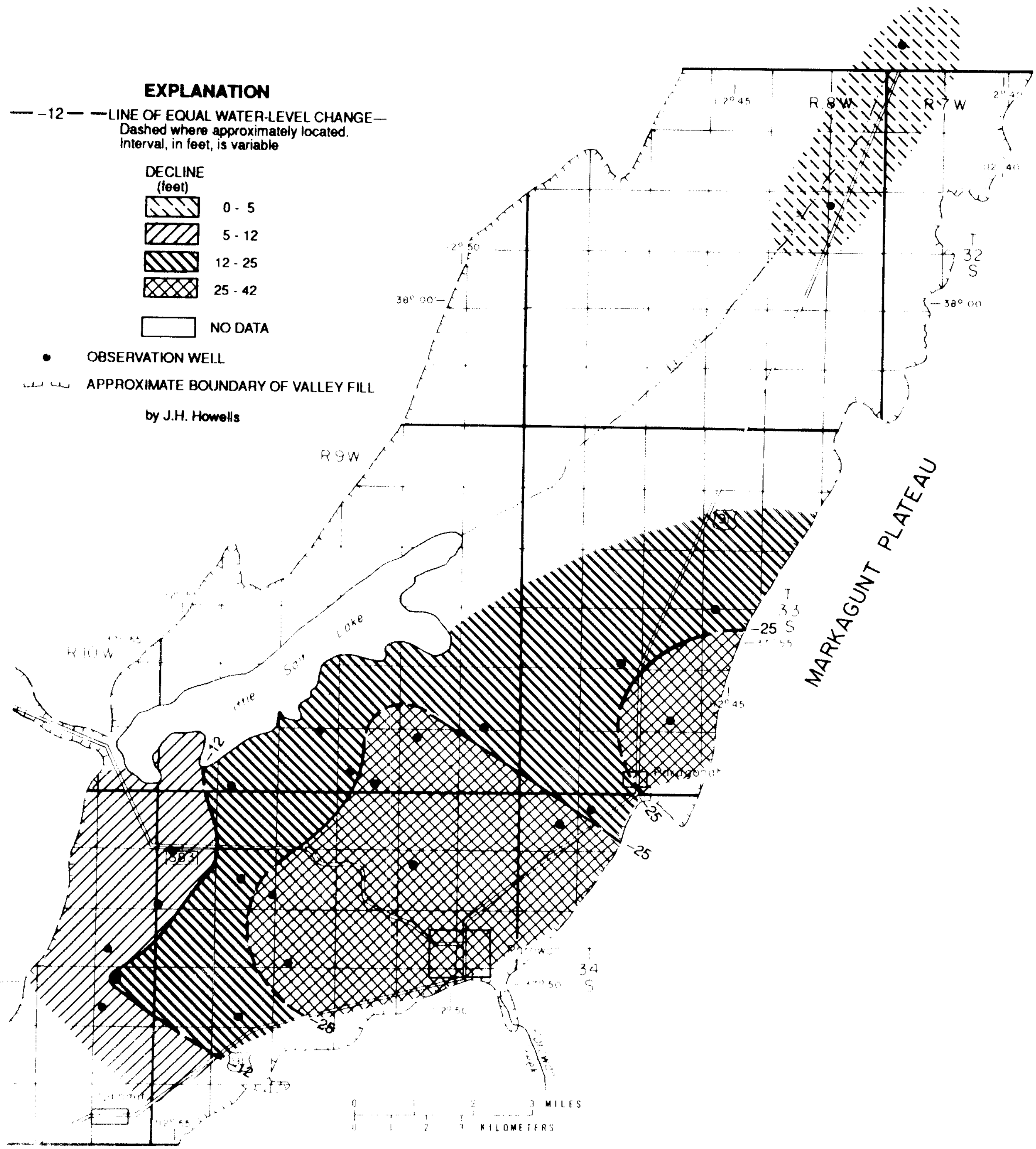


Figure 31.–Map of Parowan Valley showing change of water levels from March 1987 to March 1992.

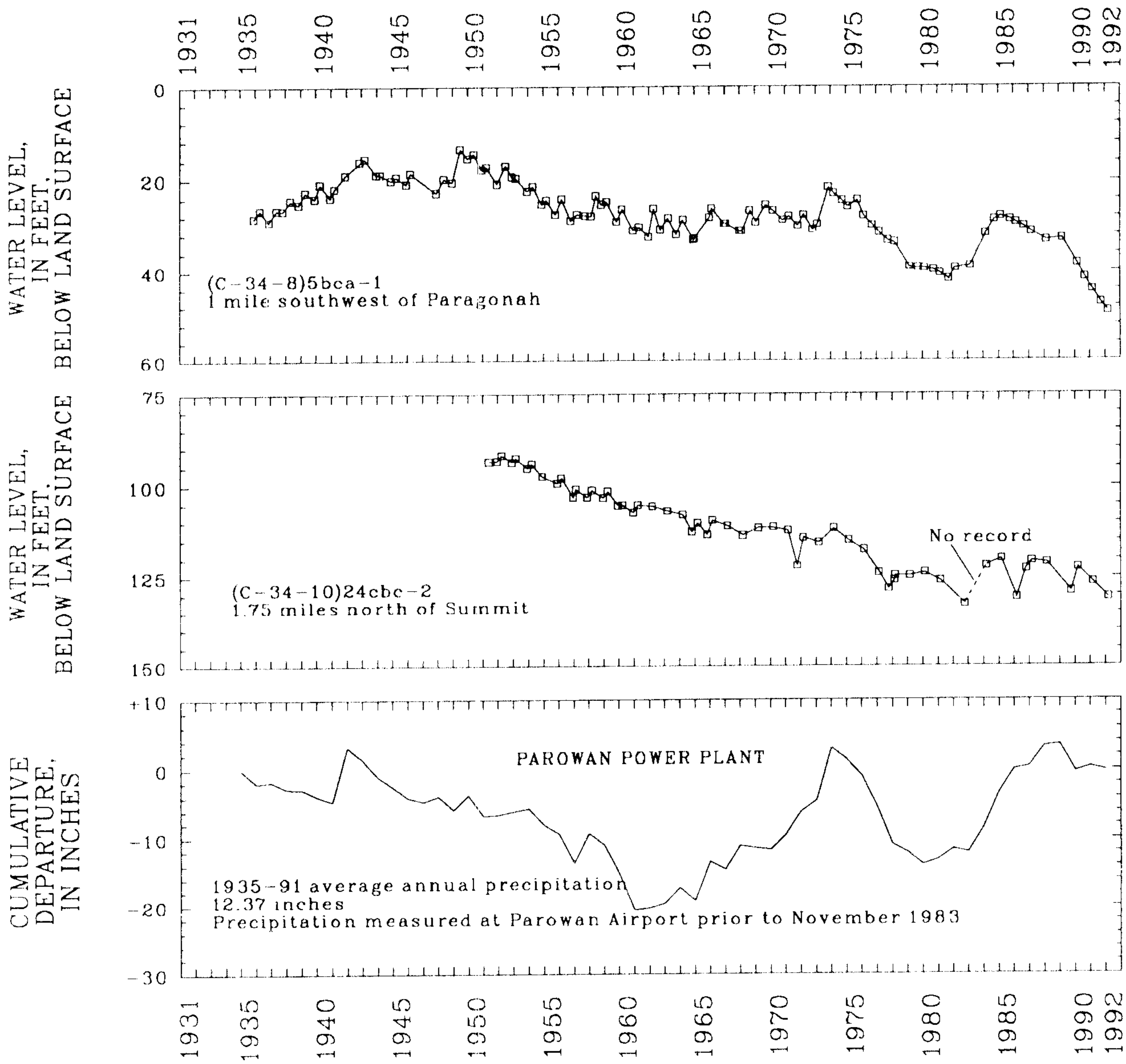


Figure 32.--Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

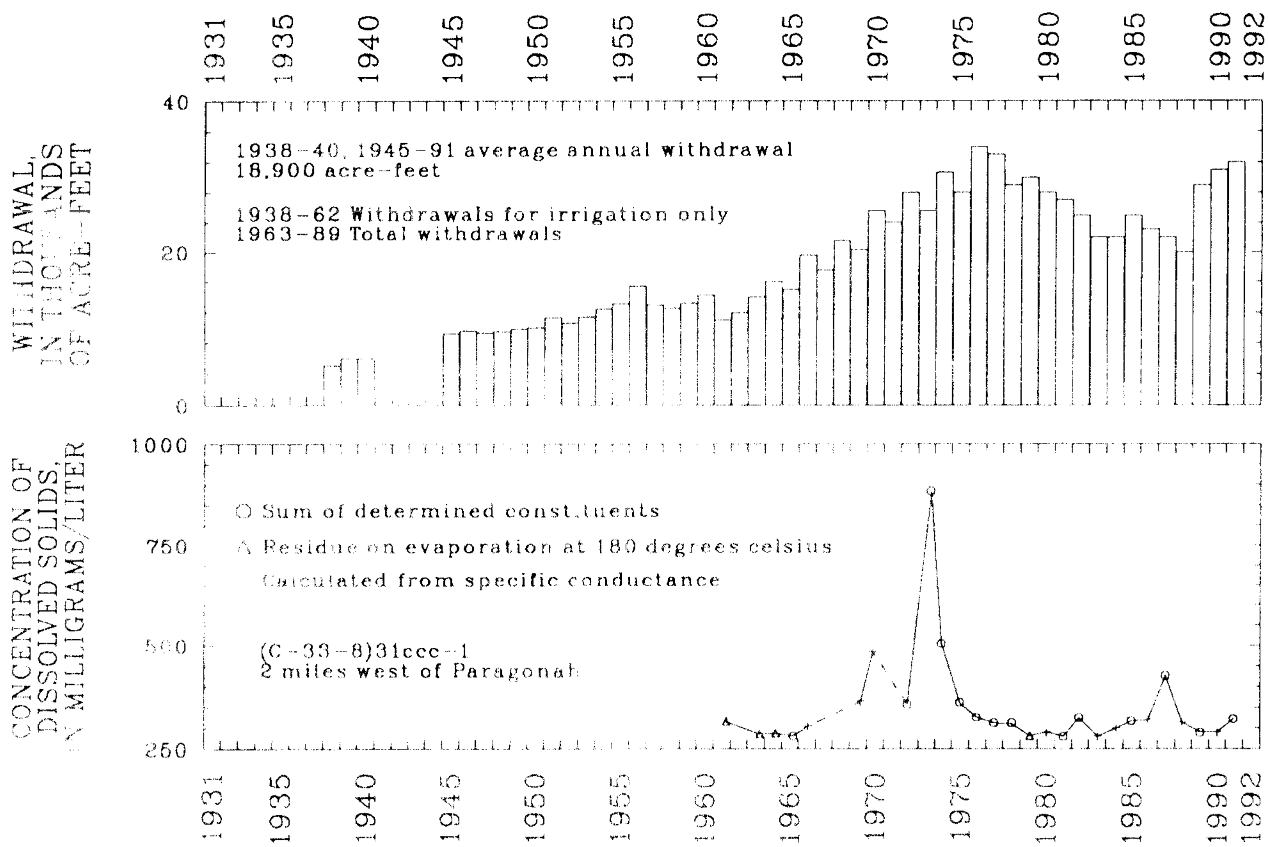


Figure 32.—Continued

ESCALANTE VALLEY

Milford Area

by B. A. Slaugh

Withdrawal of water from wells in the Milford area of the Escalante Valley in 1991 was about 54,000 acre-feet, 6,000 acre-feet more than in 1990 and 7,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). The average annual withdrawal for the five-year period 1987-91, 46,000 acre-feet, was 2,000 acre-feet more than for the preceding five-year period, 1982-86, with withdrawals increasing each year from 1988 to 1991.

Water levels declined in most of the Milford area from March 1987 to March 1992, with the greatest decline, almost 25 feet, recorded 5 miles southeast of Milford (fig. 33). Declines in water levels probably resulted from less recharge due to less-than-average precipitation during 1987-91 than during the preceding five-year period, from less recharge from the Beaver River, which has generally decreased in flow every year since 1983, and to increased withdrawals of water from wells during 1987-91, as compared with the preceding five-year period, 1982-86. Water levels rose as much as 6 feet in the northeastern part of the valley.

The relation of water levels in selected wells to precipitation at Black Rock, to discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals of water from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1 is shown in figure 34. Precipitation at Black Rock in 1991 was 9.97 inches, 0.76 inches less than the revised quantity reported for 1990 and 1.03 inches more than the 1952-91 average annual precipitation. The average annual precipitation at Black Rock during 1987-91, 9.26 inches, was 1.39 inches less than the average during 1982-86.

Discharge of the Beaver River in 1991 was about 14,300 acre-feet, approximately 1,600 acre-feet more than the previous year and about 15,100 acre-feet less than the 1931-91 average annual discharge. The average annual discharge for 1987-91 was about 22,220 acre-feet, which was approximately 49,400 acre-feet less than the average discharge for 1982-86.

The concentration of dissolved solids in water from well (C-28-11)25dcd-1 has increased from less than 600 milligrams per liter in the 1950's to about 1,500 milligrams per liter in 1991.

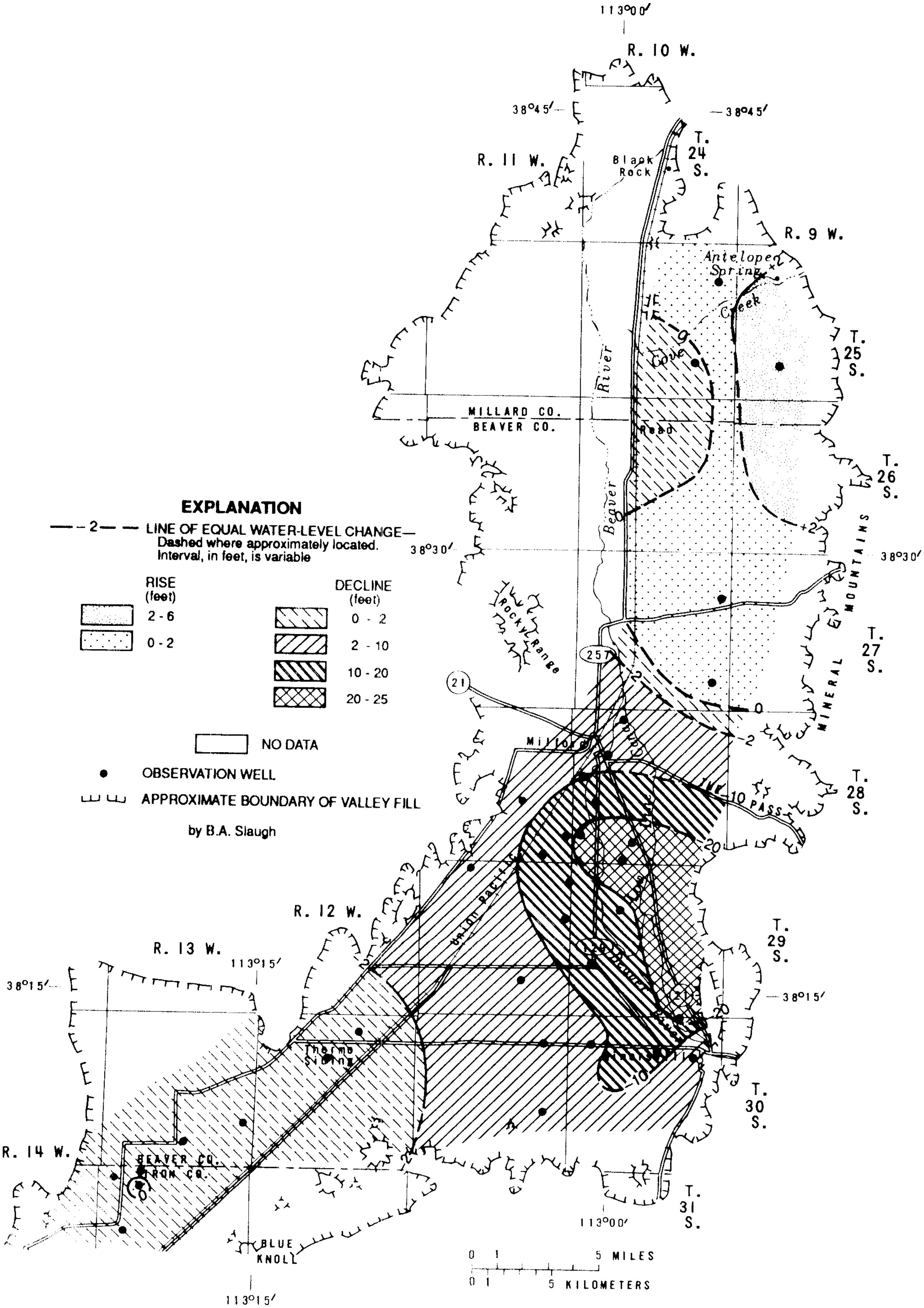


Figure 33.–Map of the Milford area showing change of water levels from March 1987 to March 1992.

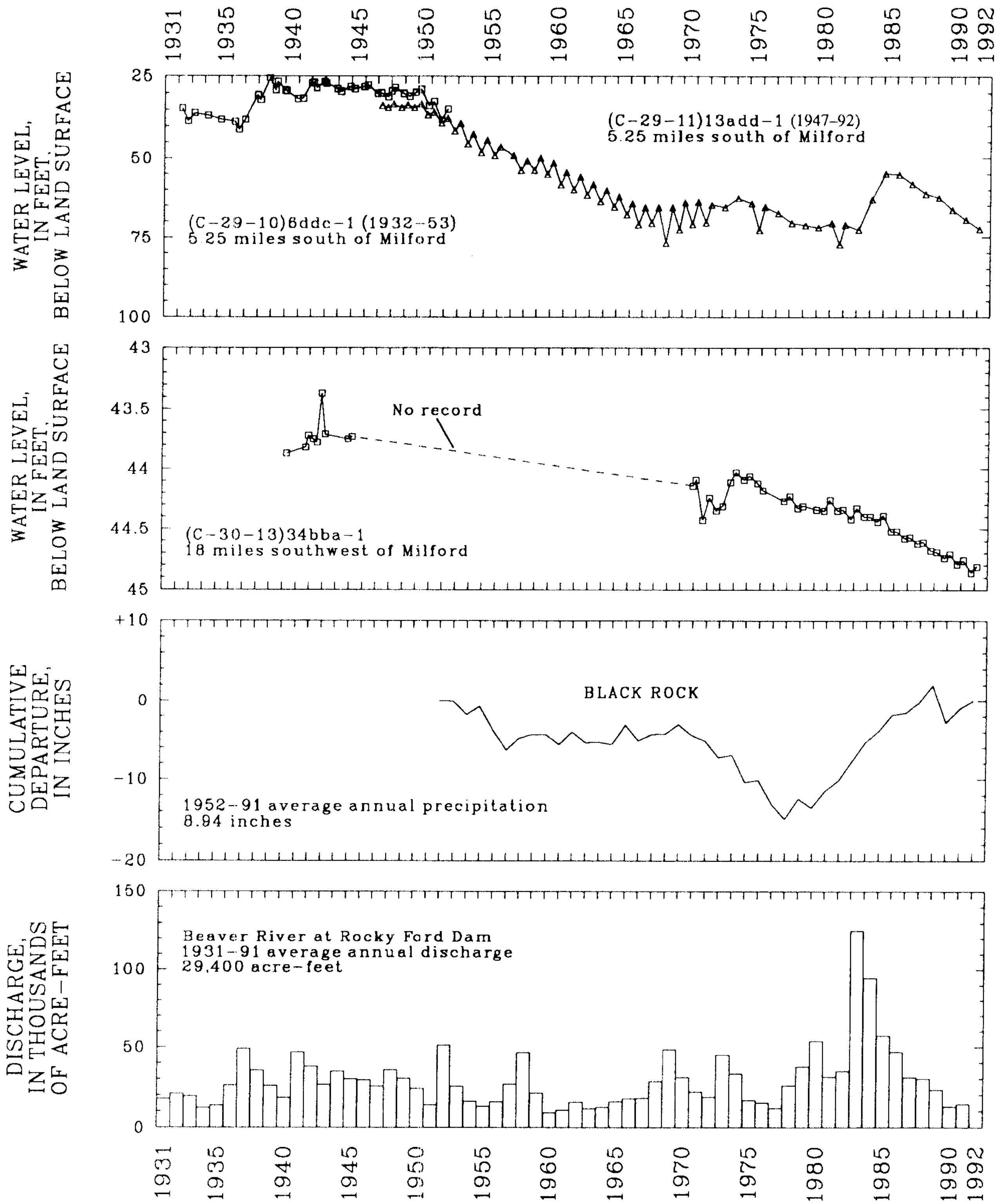


Figure 34.--Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1.

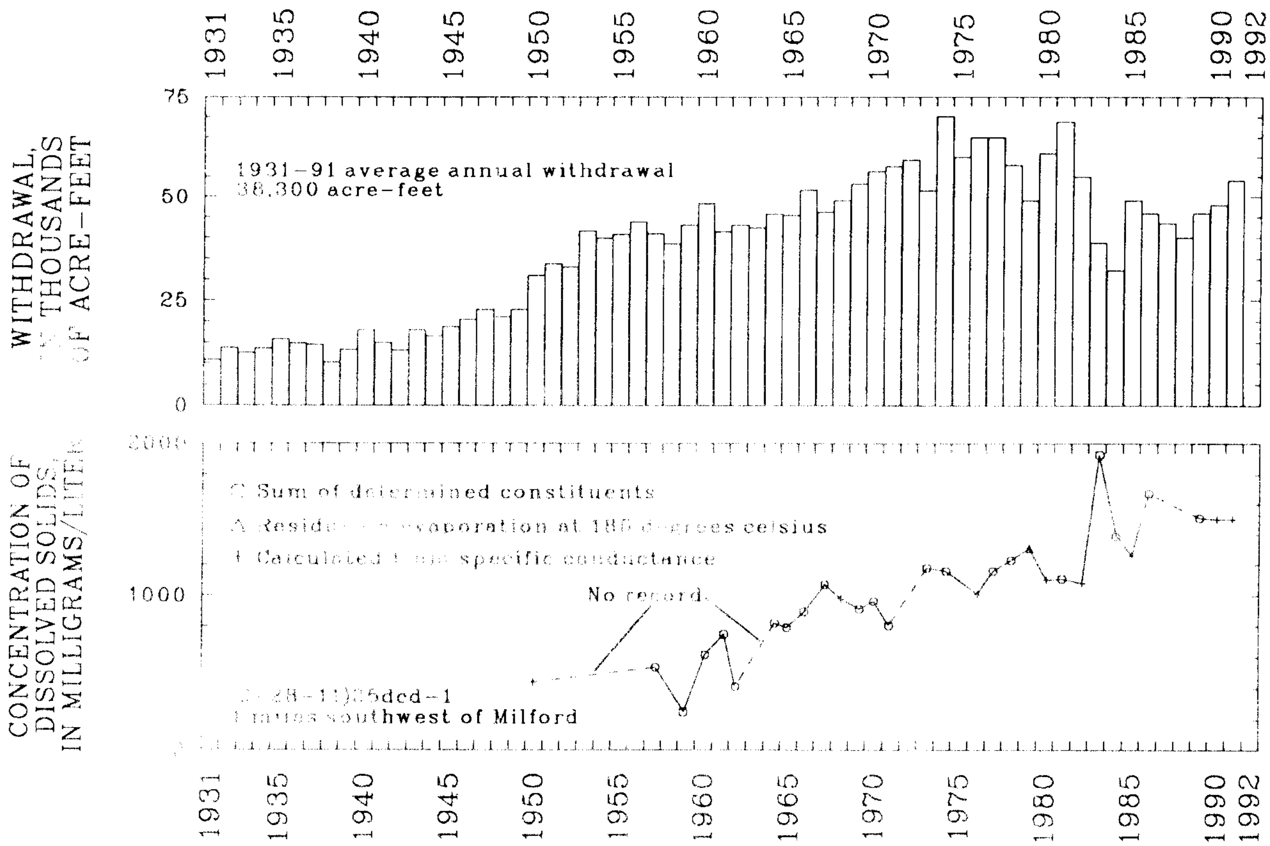


Figure 34.—Continued

ESCALANTE VALLEY

Beryl-Enterprise Area

by H. K. Christiansen

Withdrawal of water from wells in the Beryl-Enterprise area was about 79,000 acre-feet in 1991, 7,000 acre-feet less than reported in 1990, and about 13,000 acre-feet less than the average annual withdrawal for 1981-90 (tables 2 and 3). The average annual withdrawal for the 1987-91 period, 87,000 acre-feet, was 8,000 acre-feet less than the average withdrawal for the preceding five-year period, 1982-86.

Water levels declined from March 1987 to March 1991 in most of the Beryl-Enterprise area (fig. 35). The overall declines are primarily the result of continued large withdrawals for irrigation and possibly less recharge from less precipitation during 1987-91 than during the preceding five-year period. The largest declines, 16 to 31 feet, south and southwest of Beryl Junction are the result of decreased recharge and continued large withdrawals. Withdrawals of water during 1981-88 from a mine about 6 miles north of Enterprise were diverted to the area and used to recharge the ground-water system. These withdrawals and the resulting recharge ceased in December 1988.

The relation of water levels in wells (C-35-17)25cdd-1 and (C-37-16)6ccc-1 to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 36. The 1991 precipitation at Modena was 8.70 inches, 1.55 inches less than the long-term average annual precipitation for 1936-91. Average annual precipitation during 1987-91, 10.47 inches, was 1.05 inches less than the annual average for 1982-86. Water levels in well (C-37-16)6ccc-1 rose sharply during 1977-80 as a result of recharge from local flooding, but have generally declined since 1981. The concentration of dissolved solids in water from well (C-34-16)28dcc-2 has increased from about 460 milligrams per liter in 1967 to about 980 milligrams per liter in 1991.

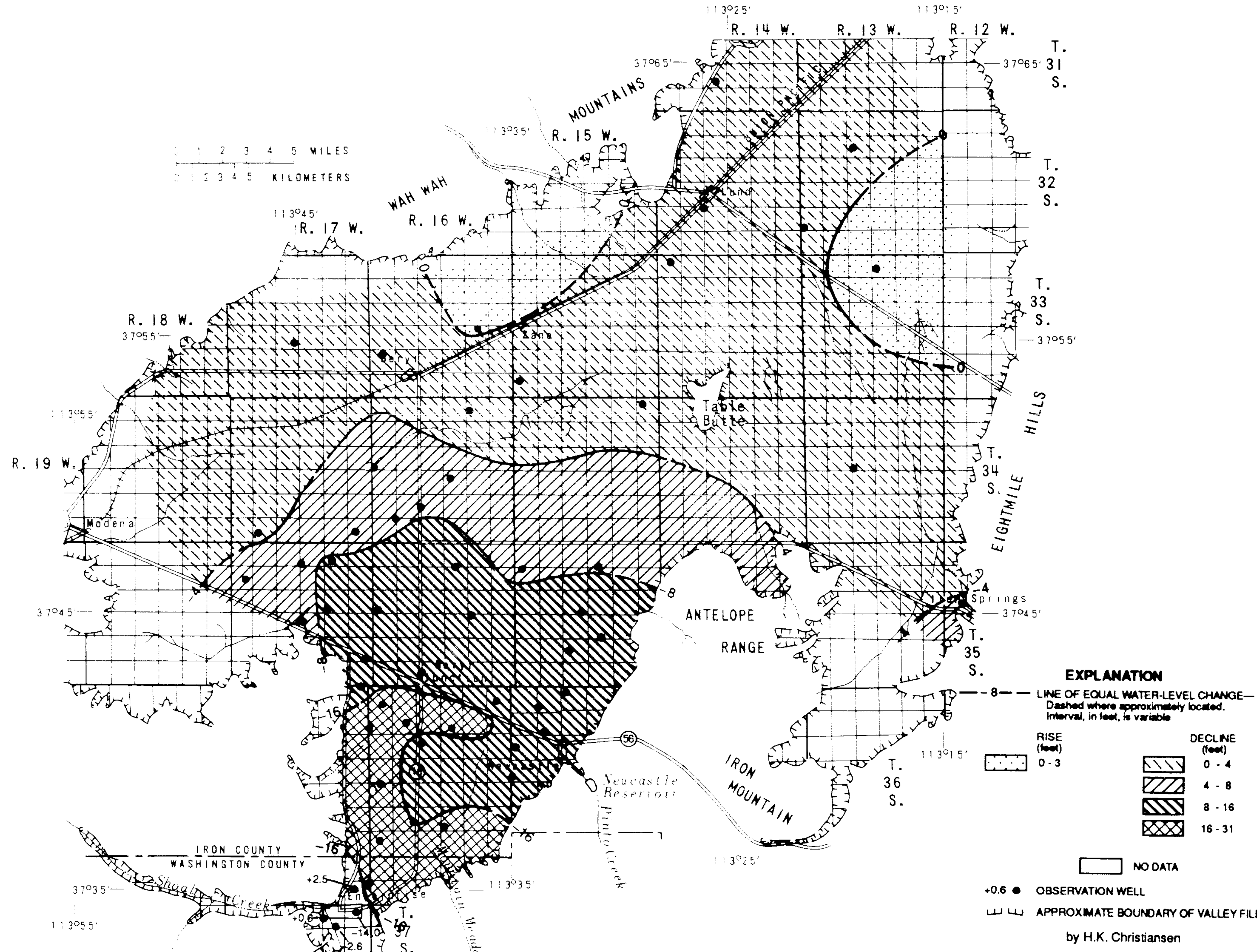


Figure 35.–Map of the Beryl-Enterprise area showing change of water levels from March 1987 to March 1992.

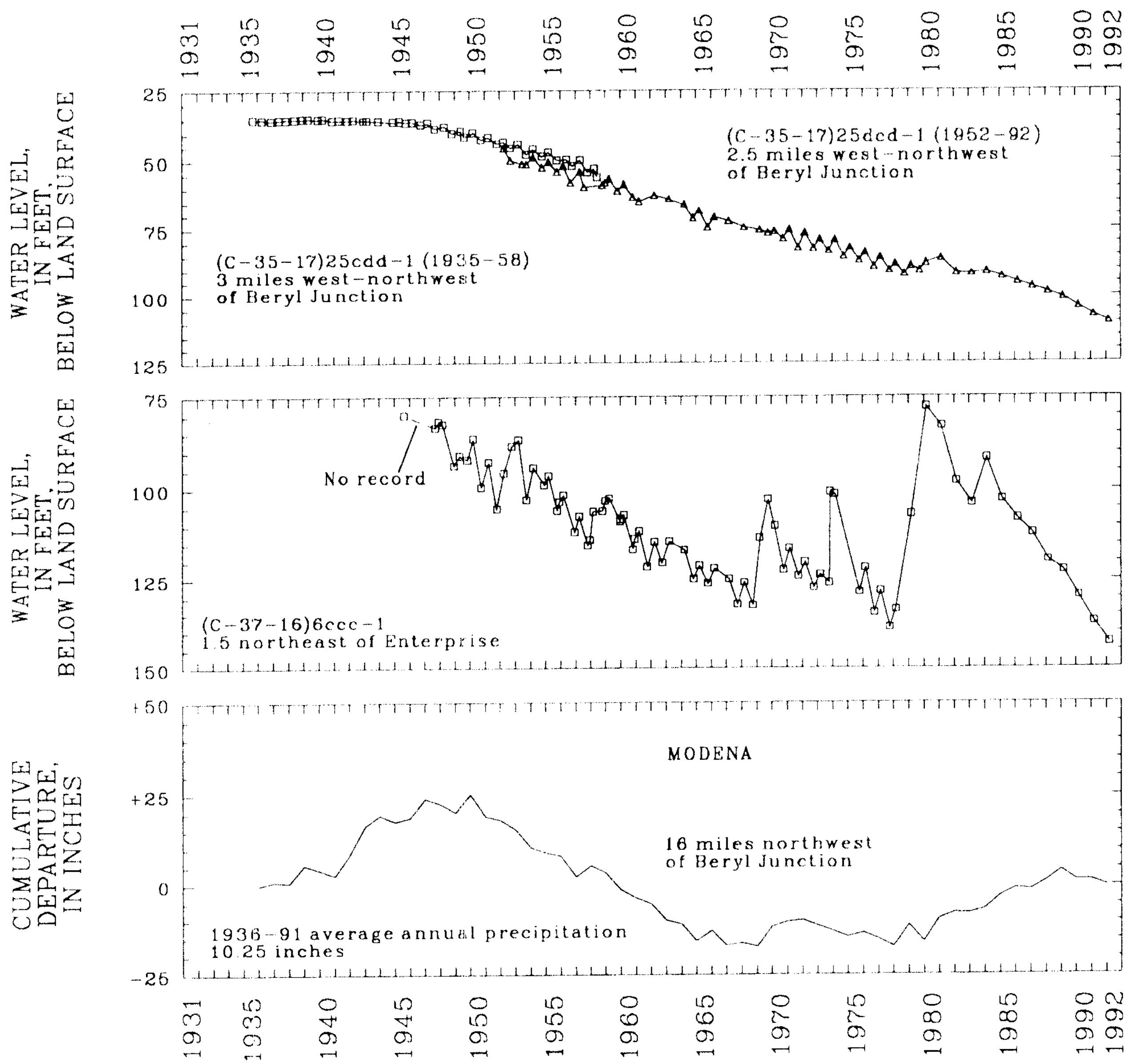


Figure 36.—Relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

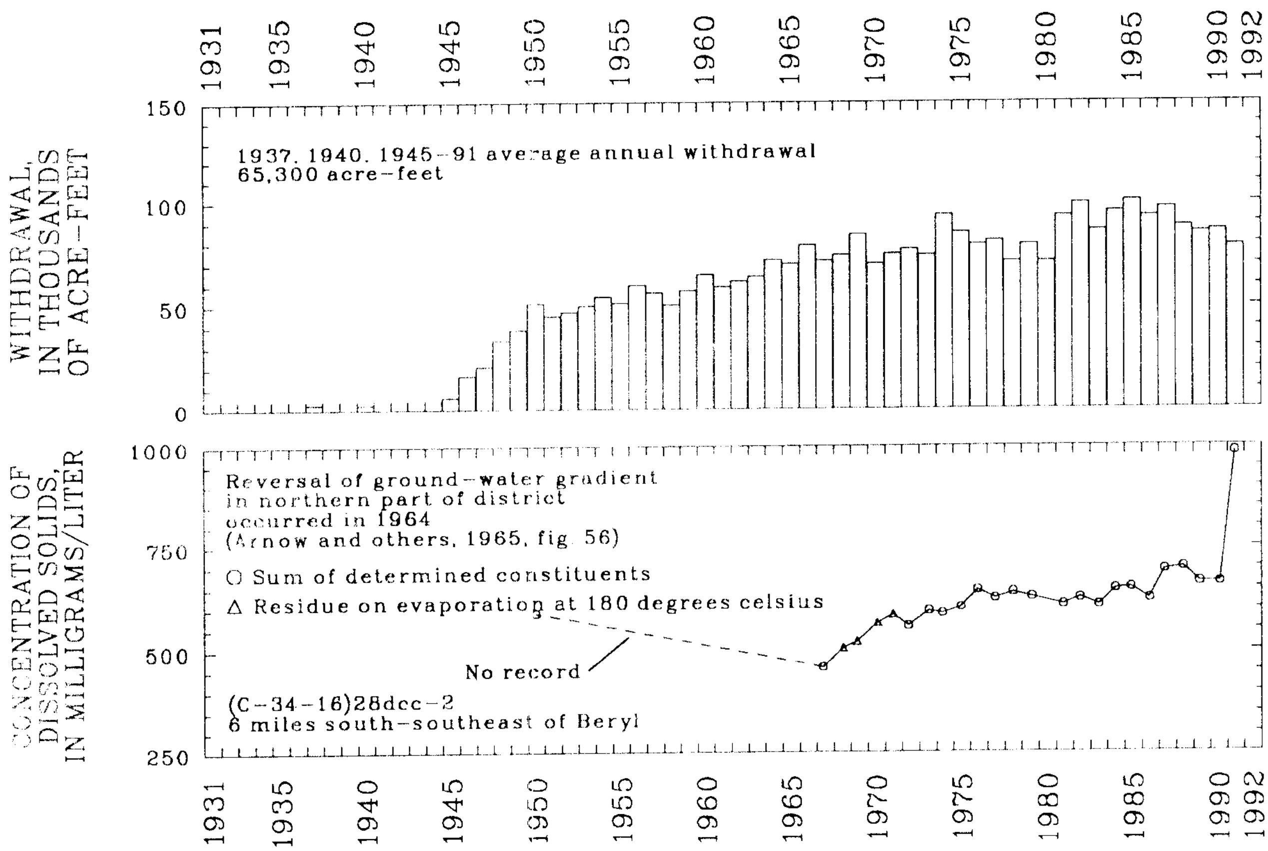


Figure 36.--Continued

CENTRAL VIRGIN RIVER AREA

by R. L. Swenson

Withdrawal of water from wells in the Central Virgin River area was about 22,000 acre-feet in 1991, the same as was reported for 1990 and 1,000 acre-feet more than the average annual withdrawal for 1981-90 (tables 2 and 3). This estimate includes water withdrawn from valley-fill aquifers that is used primarily for irrigation and water withdrawn from consolidated rocks and valley fill, most of which is used for public supply. Withdrawals for public supply decreased 4,000 acre-feet from the 1990 estimate. The average annual withdrawal for 1987-91, 21,000 acre-feet, was about the same as the average for the preceding five-year period, 1982-86.

Water levels declined in much of the central Virgin River area from February 1987 to February 1992 (fig. 37). Declines around and northwest of St. George, along the Santa Clara River drainage, and along Fort Pierce Wash near the Arizona border range from less than a foot to a maximum decline of almost 17 feet east of Fort Pierce Wash. The declines probably are the result of less recharge due to less-than-average precipitation and surface-water flow during the 1987-91 period than during the preceding five-year period, 1982-86. Rises occurred south of St. George and in the northeastern part of the area near Leeds. The greatest rise of almost 12 feet occurred southeast of St. George. The rises are probably due to local decreases in withdrawals for irrigation.

The relation of water levels in selected wells to discharge of the Virgin River at Virgin, to precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1 is shown in figure 38. Discharge of the Virgin River was about 83,440 acre-feet in 1991, which is approximately 14,000 acre-feet more than the final value reported for 1990 and about 50,260 acre-feet less than the long-term average. The 1987-91 average annual discharge of about 91,500 acre-feet was 68,300 acre-feet less than during the preceding five-year period, 1982-86. Precipitation at St. George in 1991 was 5.71 inches, which is 2.09 inches less than the average annual precipitation for 1947-91. The average annual precipitation during 1987-91, 7.46 inches, was 1.49 inches less than the average for the preceding five-year period, 1982-86. The graph of concentration of dissolved solids in water from well (C-41-17)17cba-1 indicates little overall change since 1966.

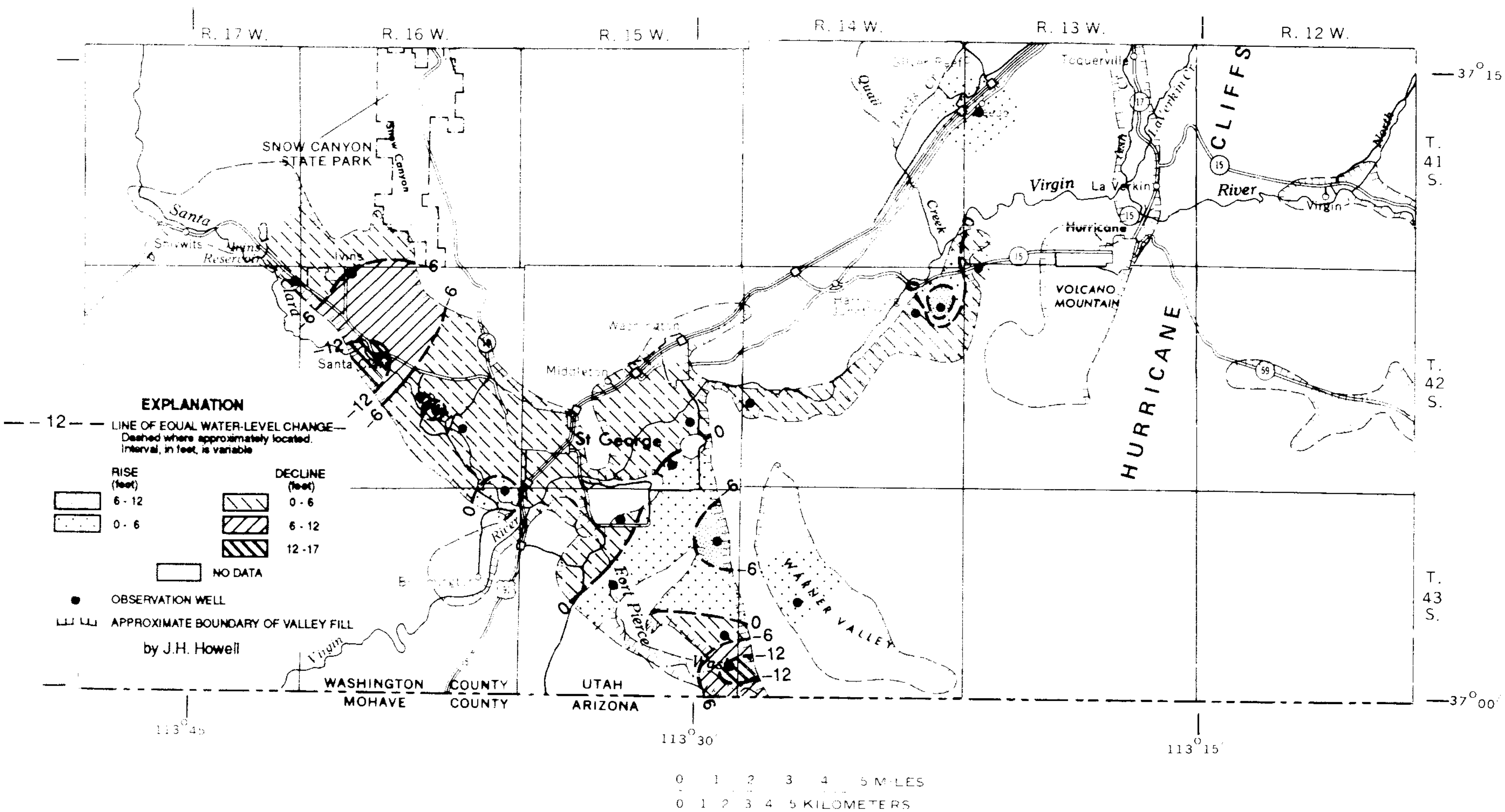


Figure 37.–Map of the central Virgin River area showing change of water levels from February 1987 to February 1992.

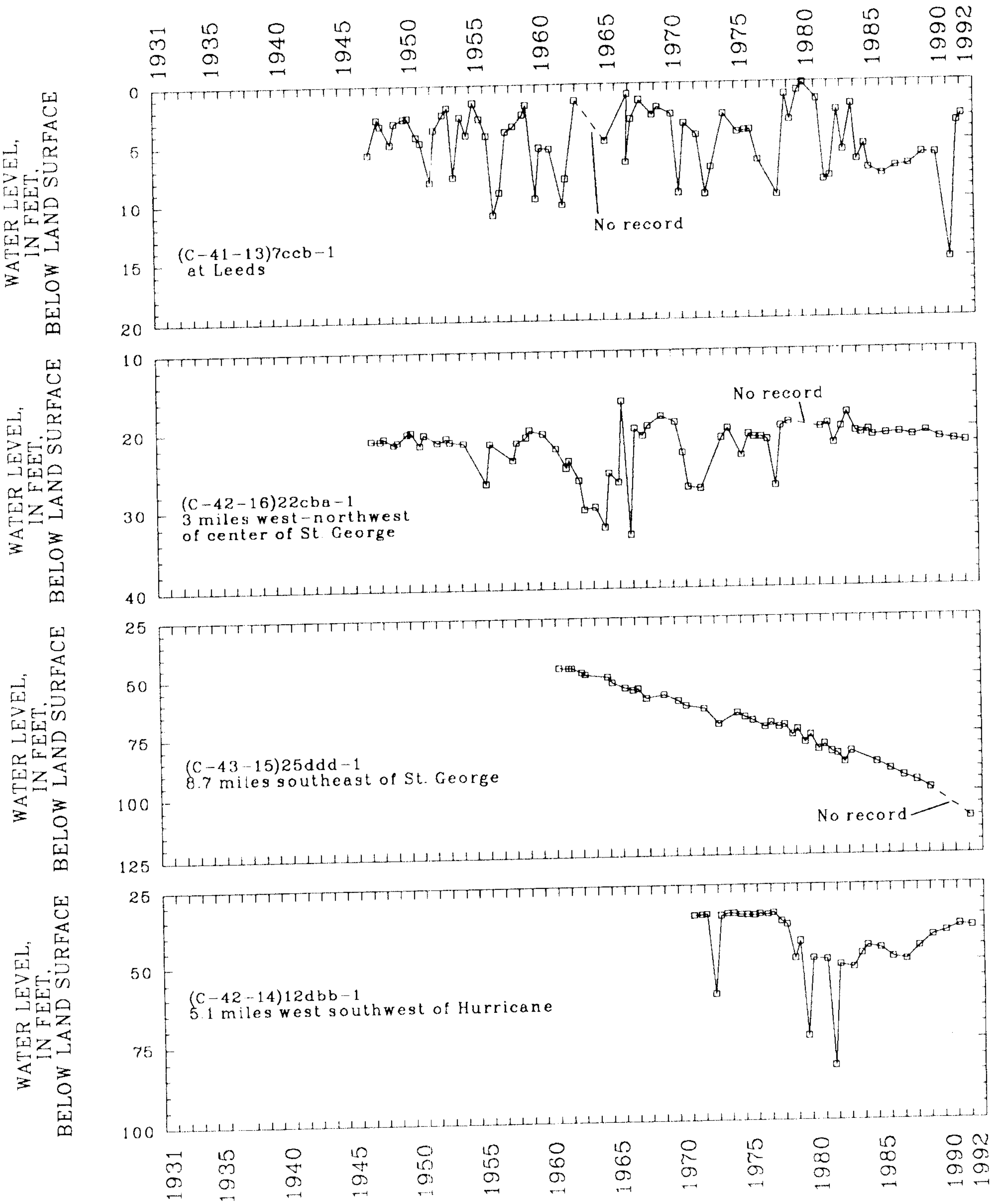
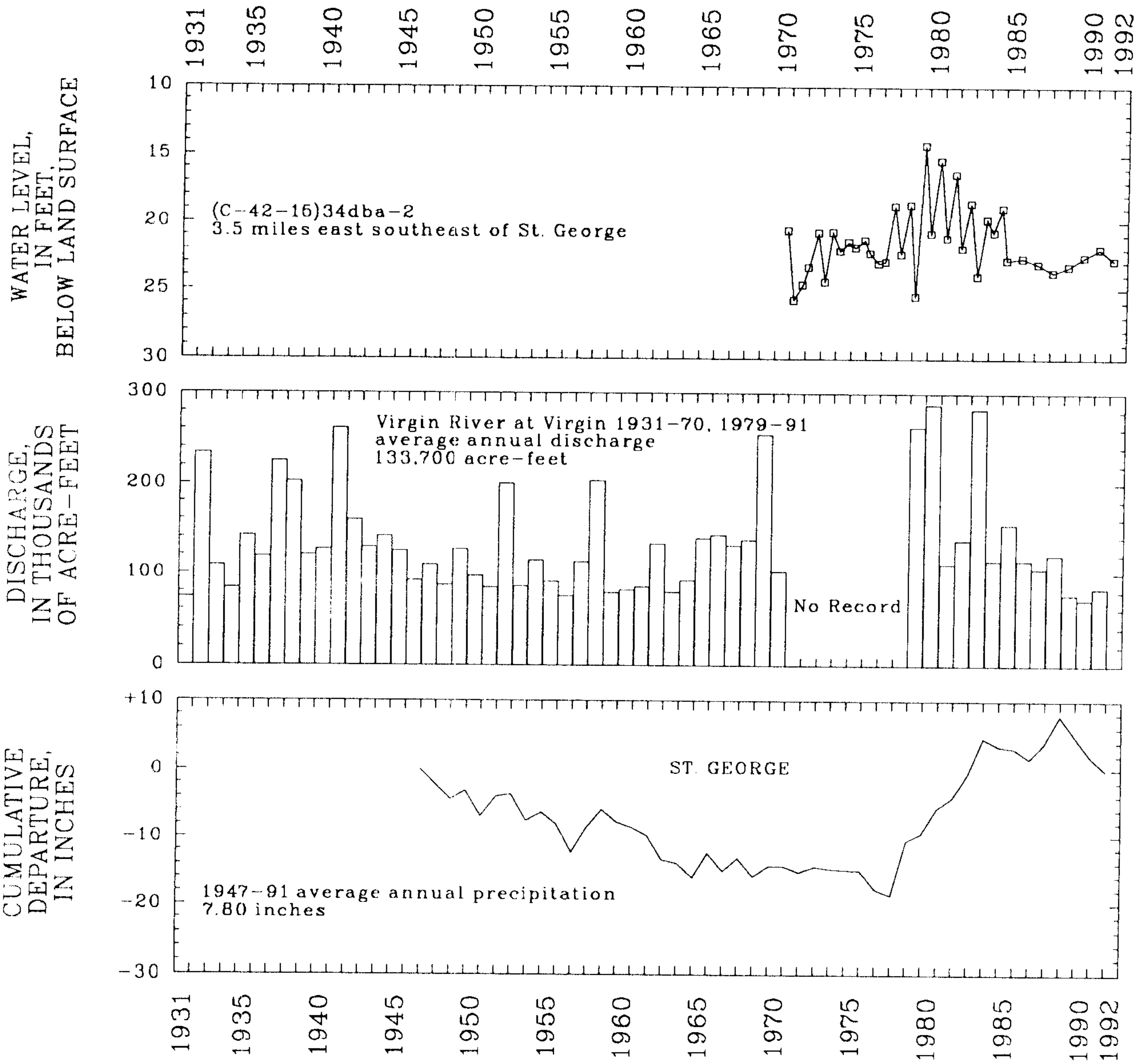


Figure 38.—Relation of water levels in selected wells in the central Virgin River area to discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1.



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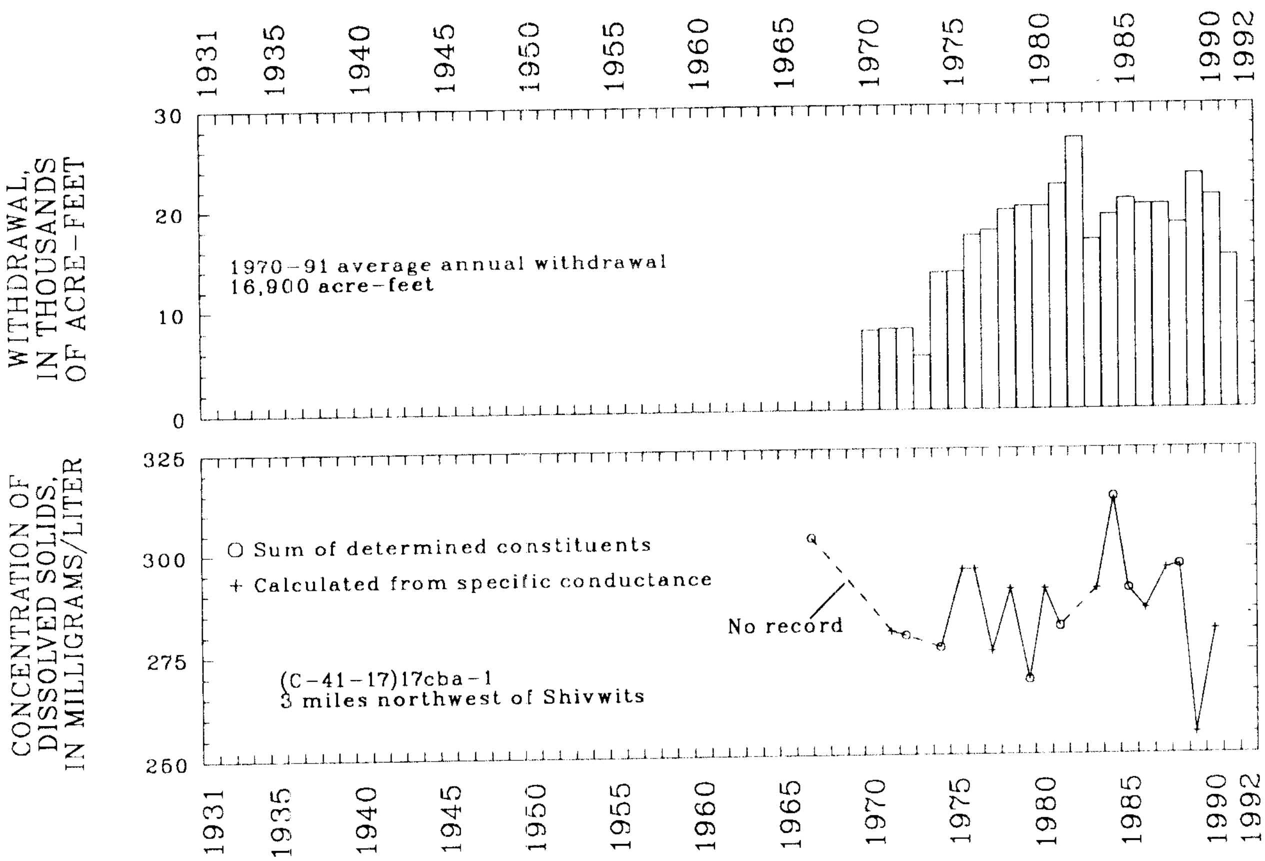


Figure 38.--Continued

OTHER AREAS

by B. K. Thomas

Approximately 111,000 acre-feet of water was withdrawn from wells in 1991 in those areas of Utah listed below:

Number in figure 1	Area	Estimated withdrawal (acre-feet)	
		1991	1990
1	Grouse Creek Valley	3,700	4,000
2	Park Valley	3,100	3,300
3	Ogden Valley	12,200	12,300
12	Dugway Area, Skull Valley, and Old River Bed	4,400	6,700
13	Cedar Valley, Utah County	2,500	4,300
18	Sanpete Valley	13,500	[1]15,400
23	Snake Valley	8,400	8,500
25	Beaver Valley	7,400	7,500
	Remainder of state	56,200	49,400
Total (rounded)		111,000	[1]111,000

[1] Previously unpublished revision.

The total withdrawal was the same as the revised value for 1990 (table 2) and 26,000 acre-feet more than the average withdrawal for 1981-90 (table 3). The average annual withdrawal for 1987-91, 99,000 acre-feet, was 23,000 acre-feet more than the average withdrawal during the preceding five-year period, 1982-86 (table 2). In each of the areas listed, withdrawals in 1991 were less than in 1990, except in the "Remainder of the State", where withdrawals were greater in 1991 than in 1990.

Water-level changes in Cedar Valley, Utah County and Sanpete Valley from March 1987 to March 1992 are shown in figures 39 and 40.

Water levels declined along the west side of Cedar Valley, probably due to less recharge because of less-than-average precipitation during 1987-91 than during the preceding five-year period, 1982-86. The average annual precipitation at Fairfield during 1987-91 was 10.26 inches, 7.63 inches less than the average during the preceding five-year period, 1982-86. Local rises in water levels along the east side of the valley may be the result of increased local recharge or decreased local withdrawals.

Water levels also declined in Sanpete Valley, and this decline is probably the result of less recharge because of less-than-average precipitation during 1987-91 than during the preceding five-year period, 1982-86. The average annual precipitation at Manti during 1987-91 was 12.52 inches, 4.90 inches less than the average during the preceding five-year period. In addition, the average annual withdrawal of water from wells in Sanpete Valley during 1987-91 was 14,000 acre-feet, about 6,000 acre-feet more than during 1982-86. This increased withdrawal probably contributed to the decline in water levels during 1987-92.

The relation of water levels in 19 selected observation wells to the cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 41. Water levels declined from March 1987 to March 1992 in 13 of the 19 observation wells, in contrast to water-level rises during 1982-87 in 12 of the 19 wells, with no change in one well. The declines probably were due to less recharge resulting from less precipitation during 1987-91 than during 1982-86, and to larger average withdrawals of water from wells during 1987-91 than during 1982-86. Average annual precipitation during 1987-91 was less than during 1982-86 at all of the 17 stations near the observation wells.

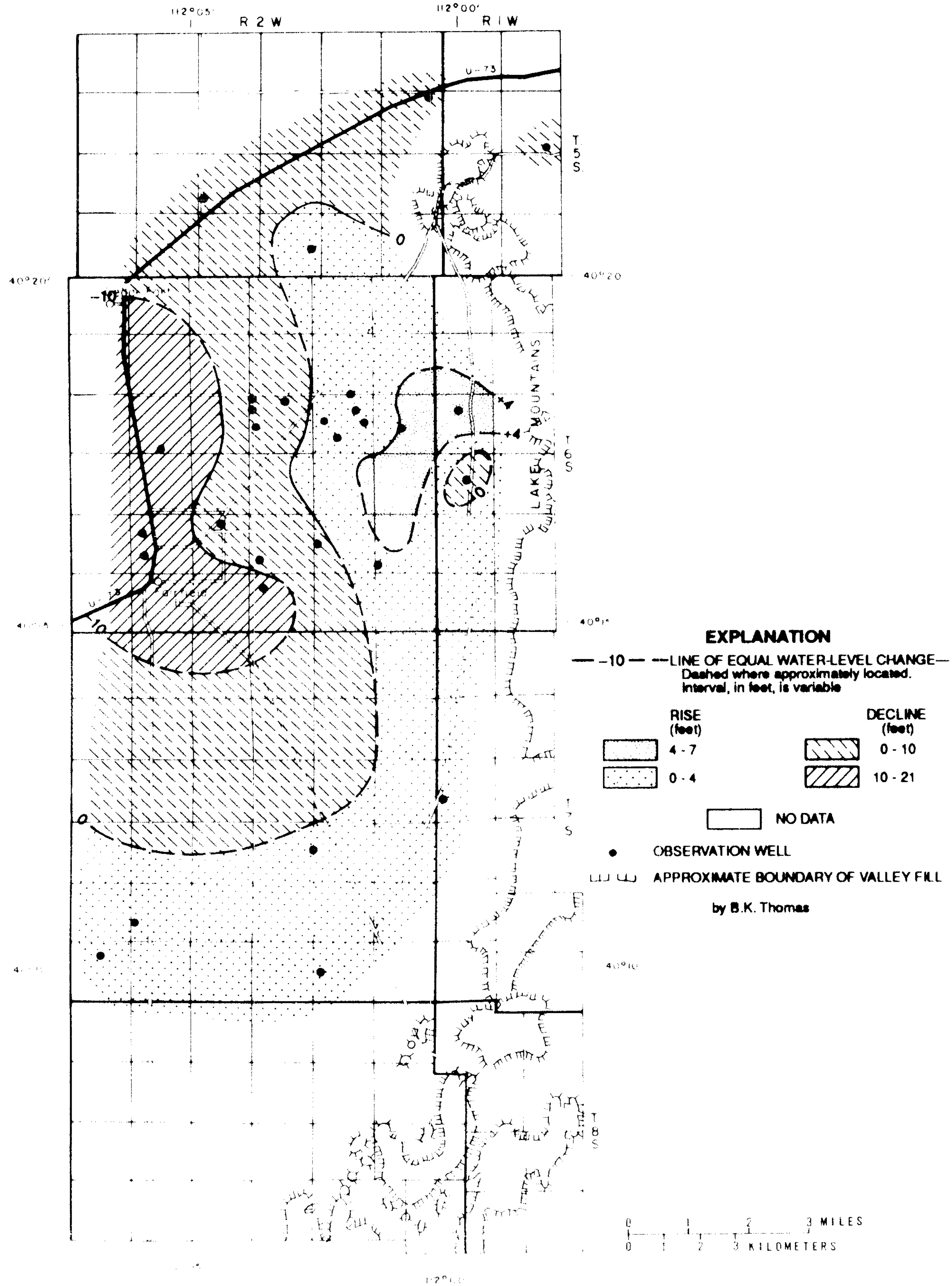


Figure 39.--Map of Cedar Valley, Utah County, showing change of water levels from March 1987 to March 1992.

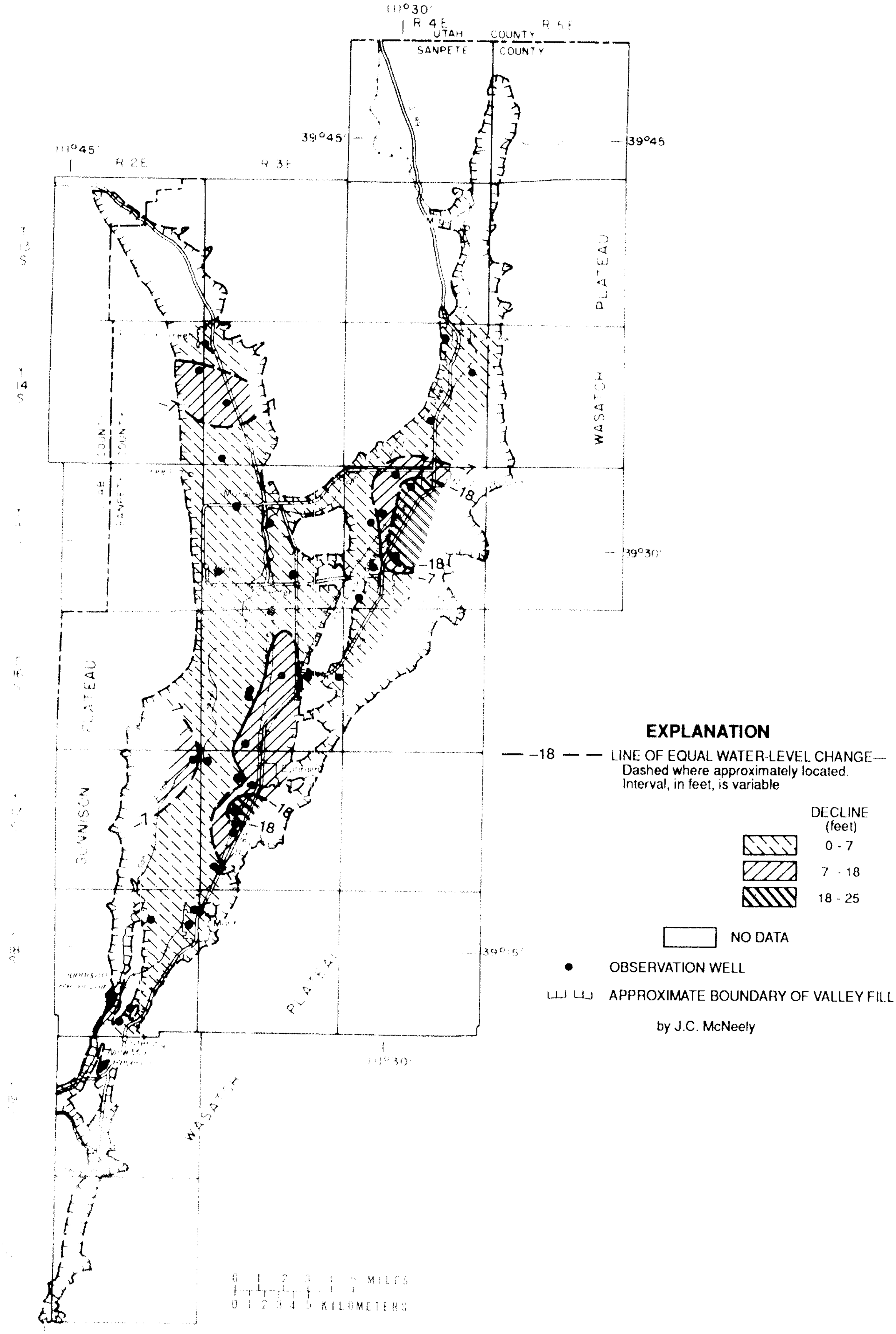


Figure 40.--Map of Sanpete Valley showing change of water levels from March 1987 to March 1992.

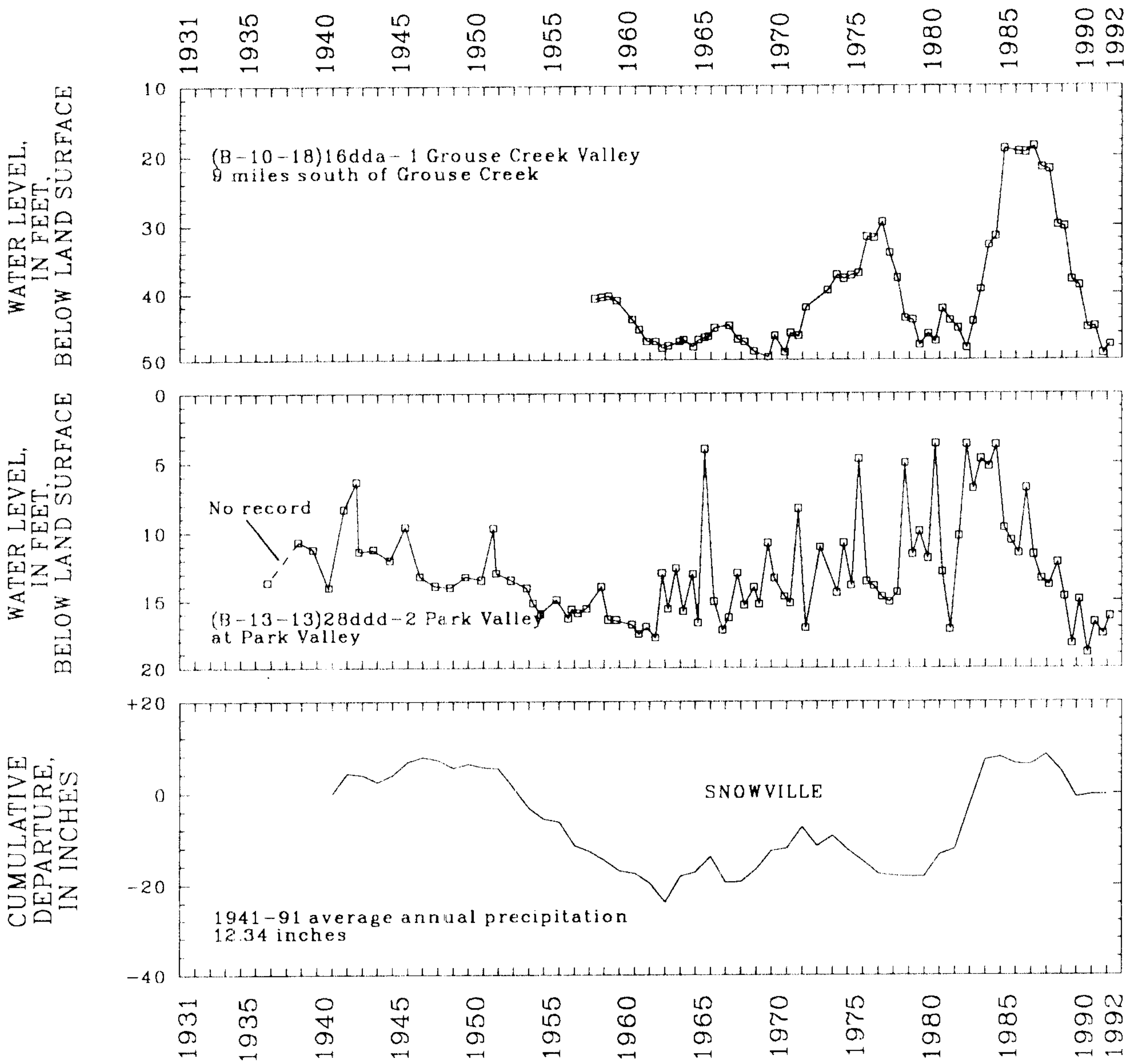
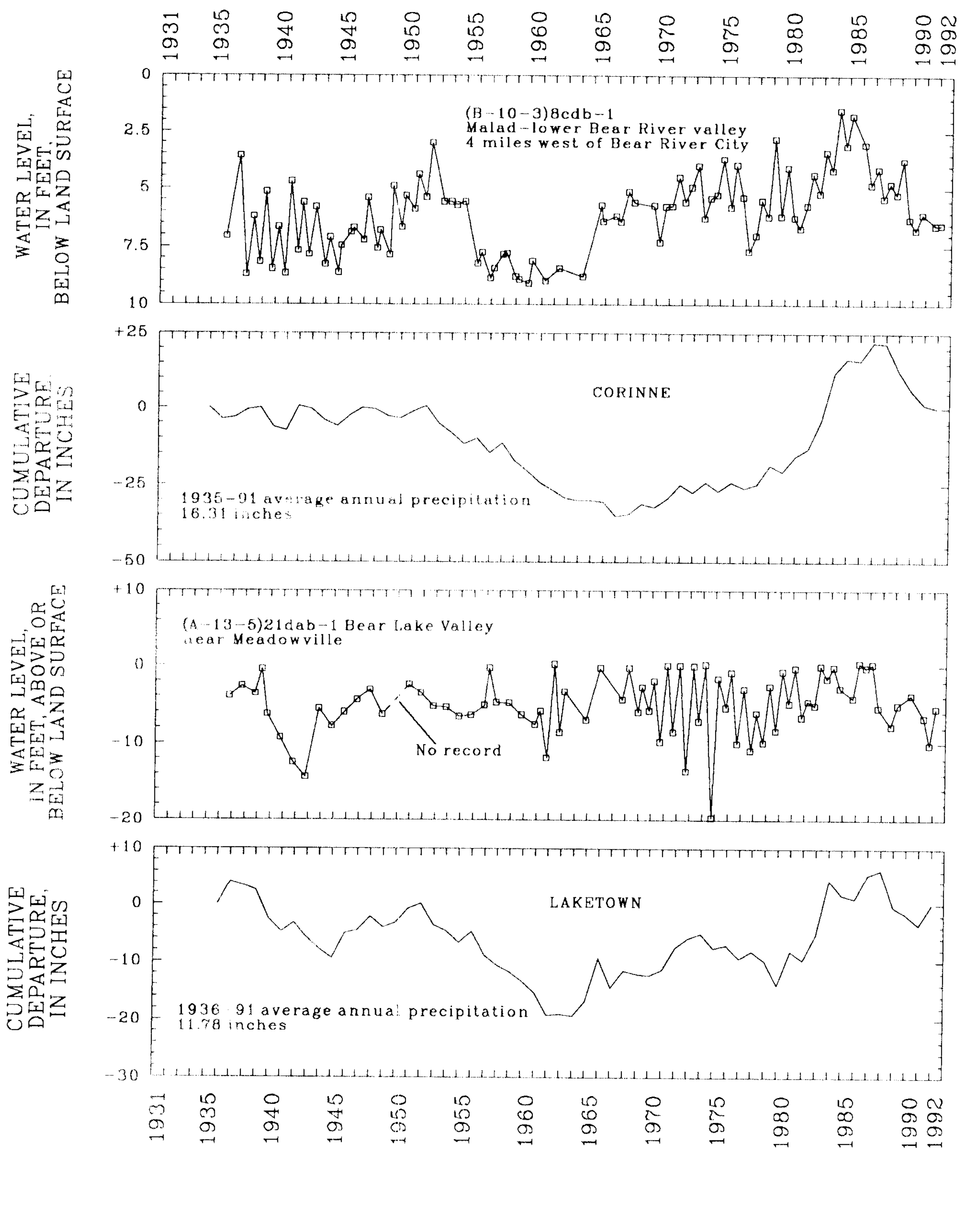


Figure 41.--Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.



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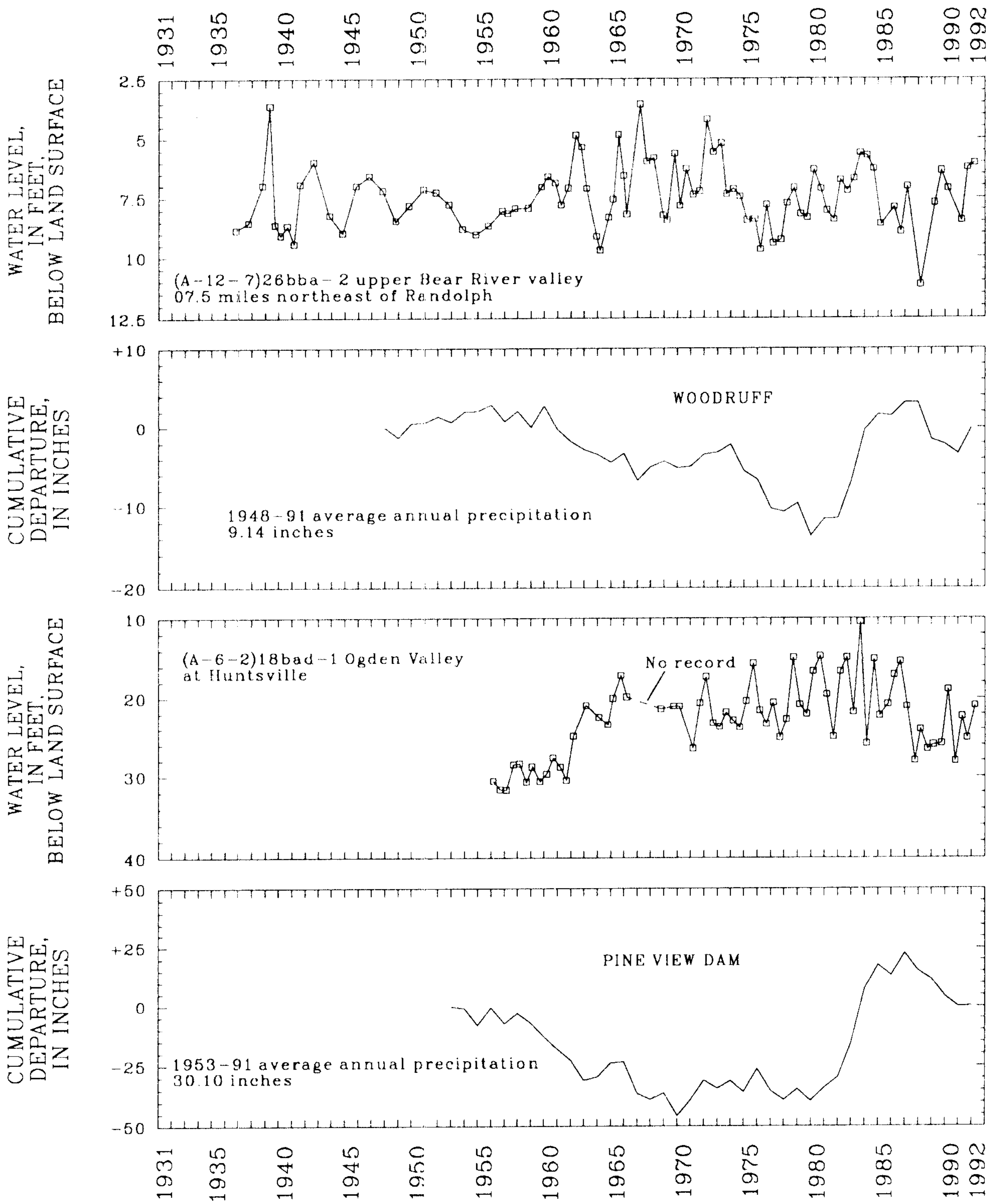

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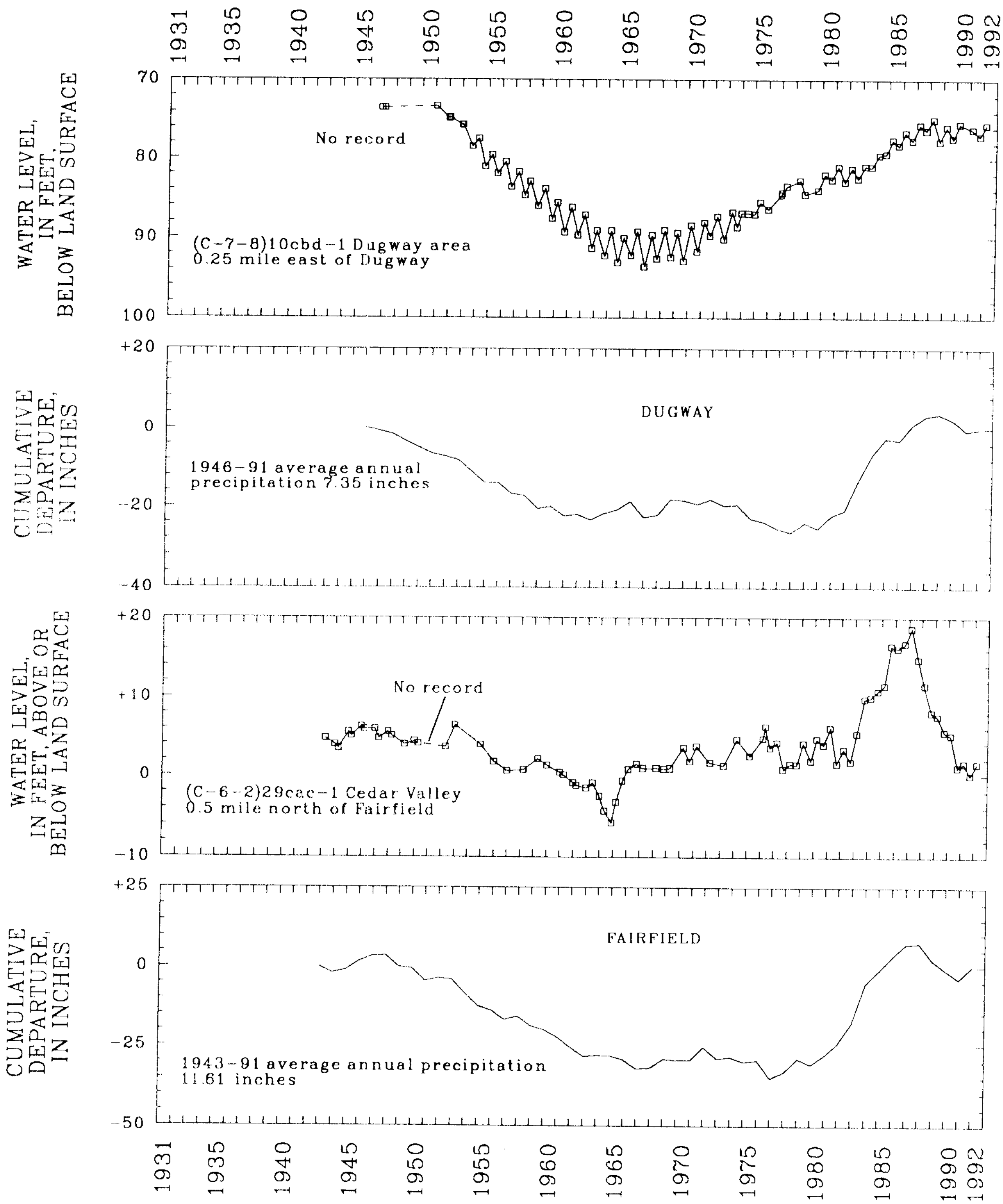

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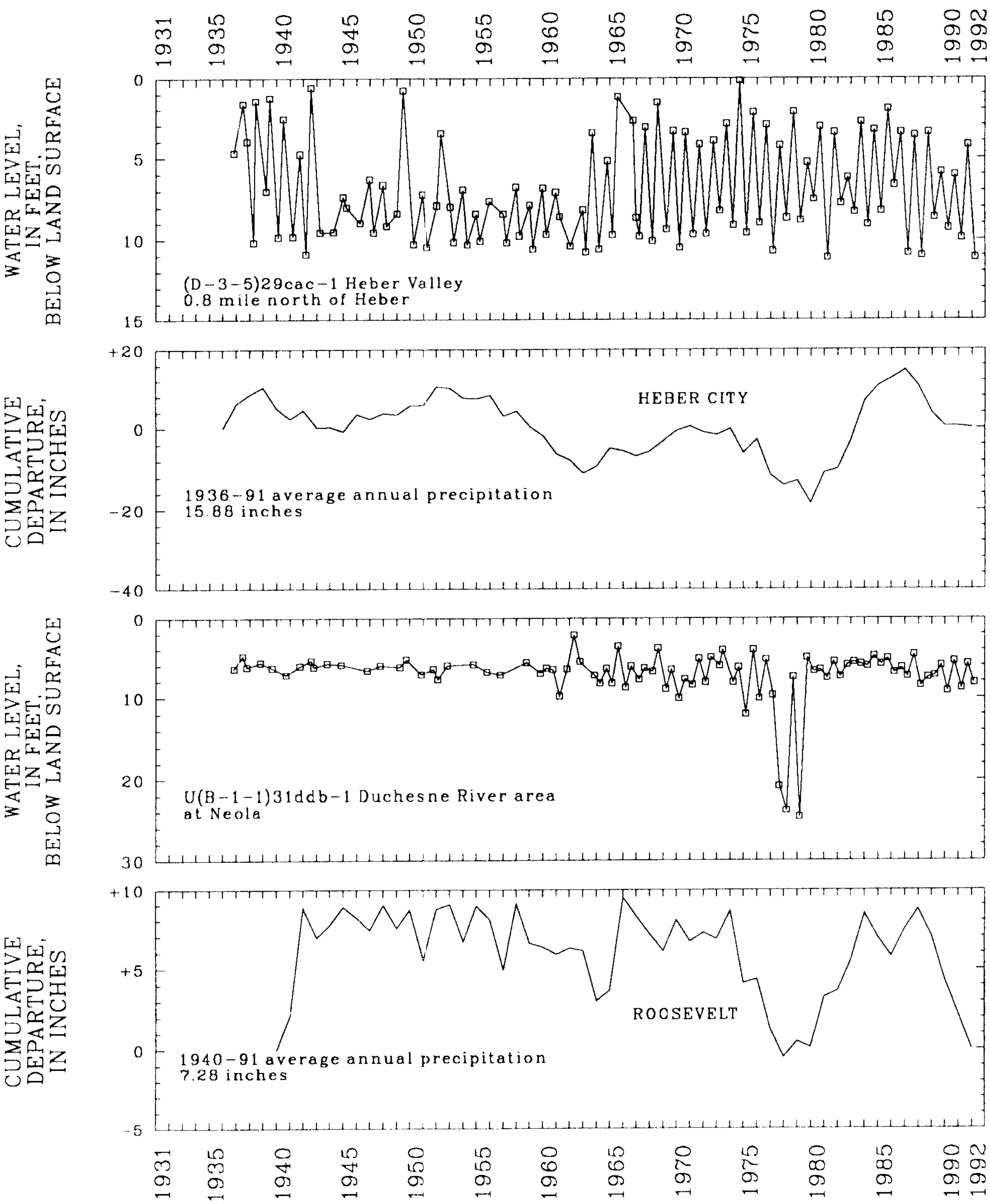

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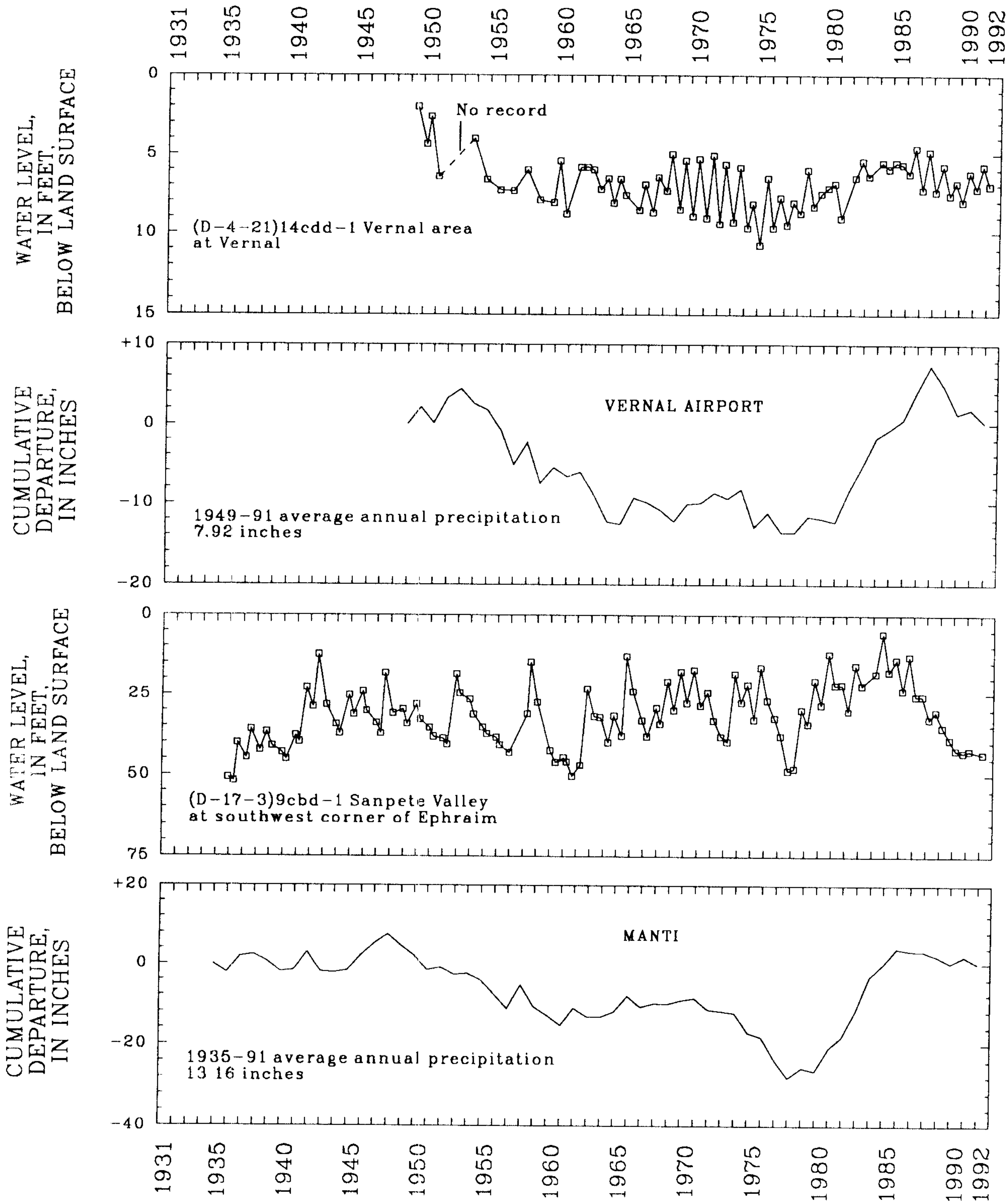

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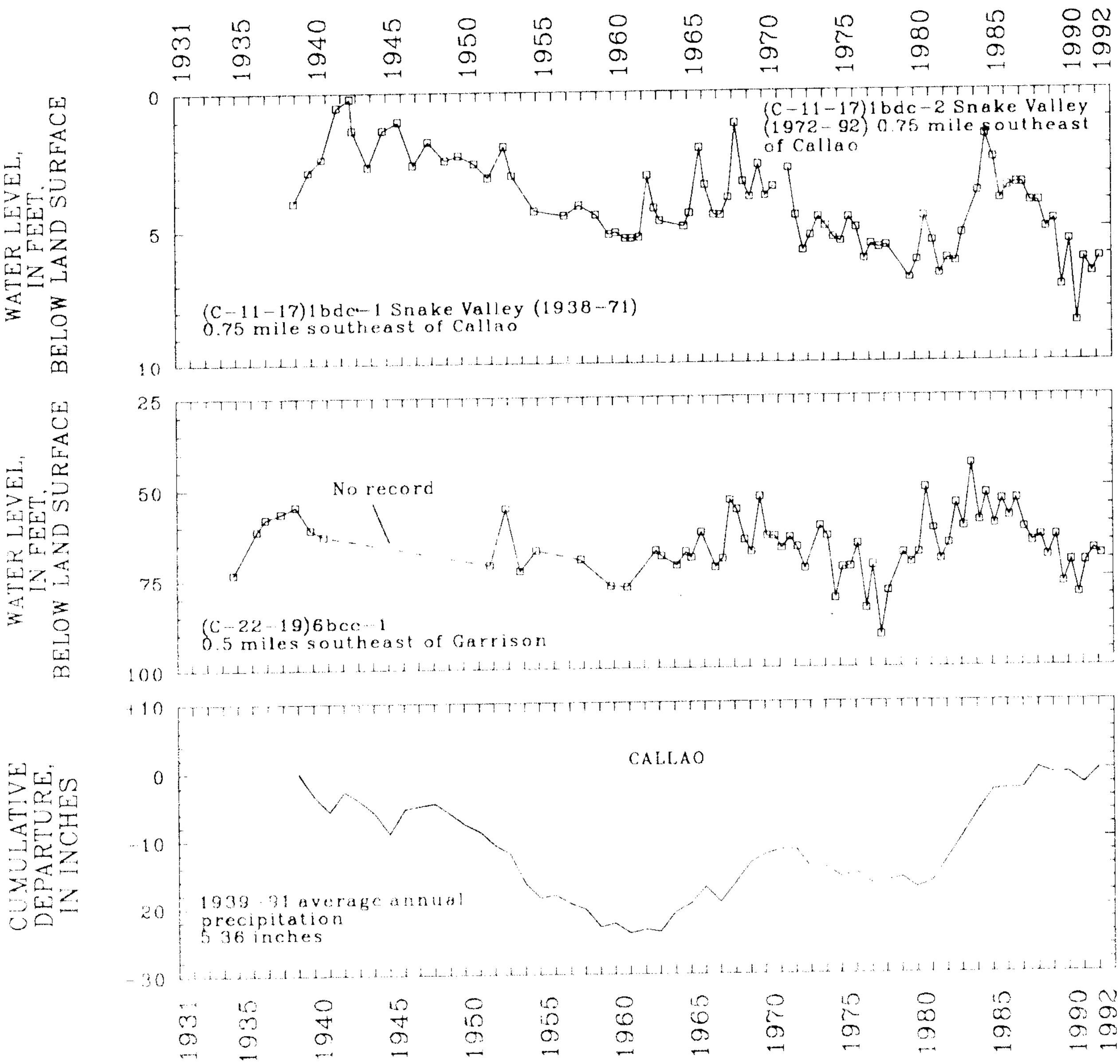

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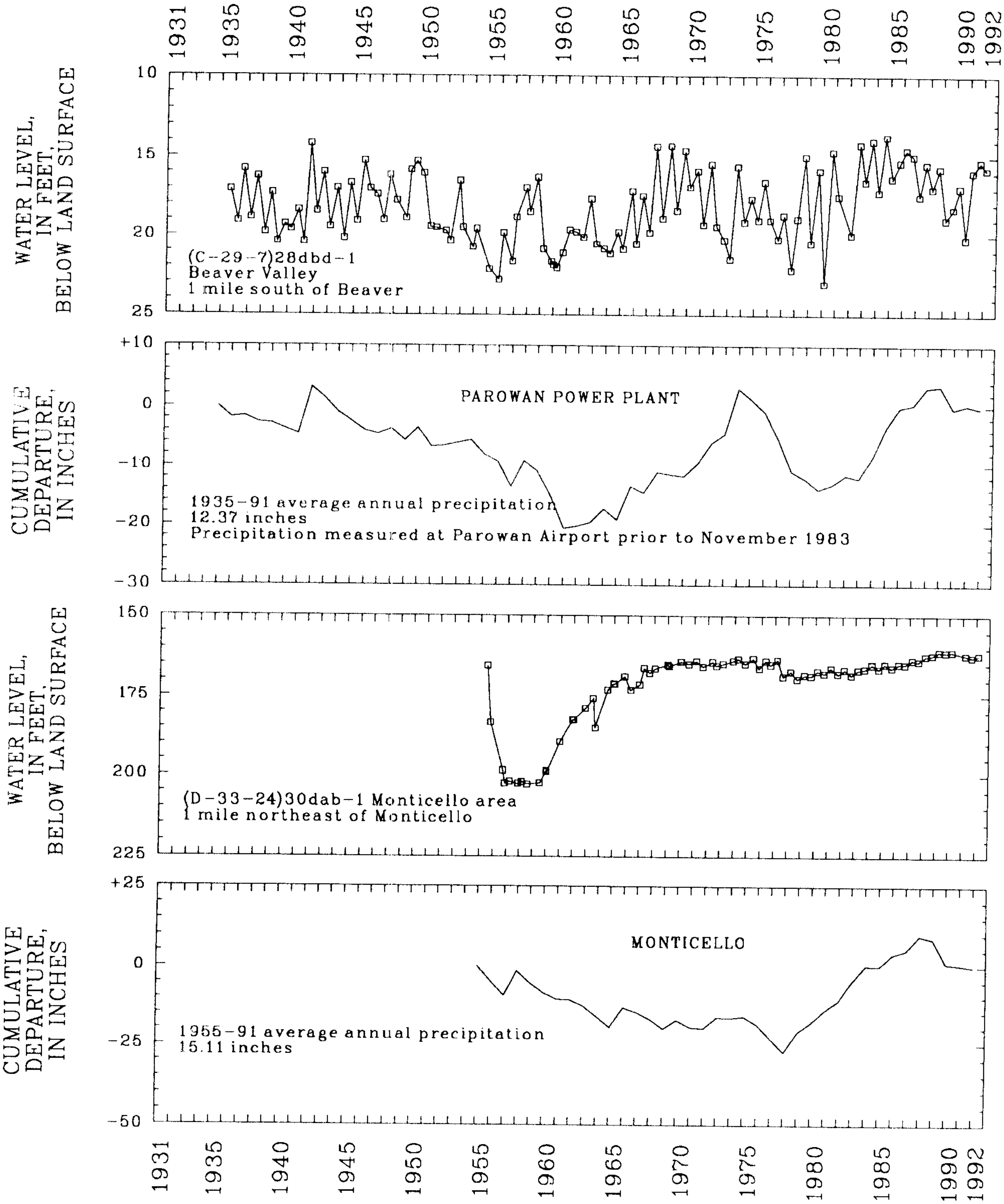

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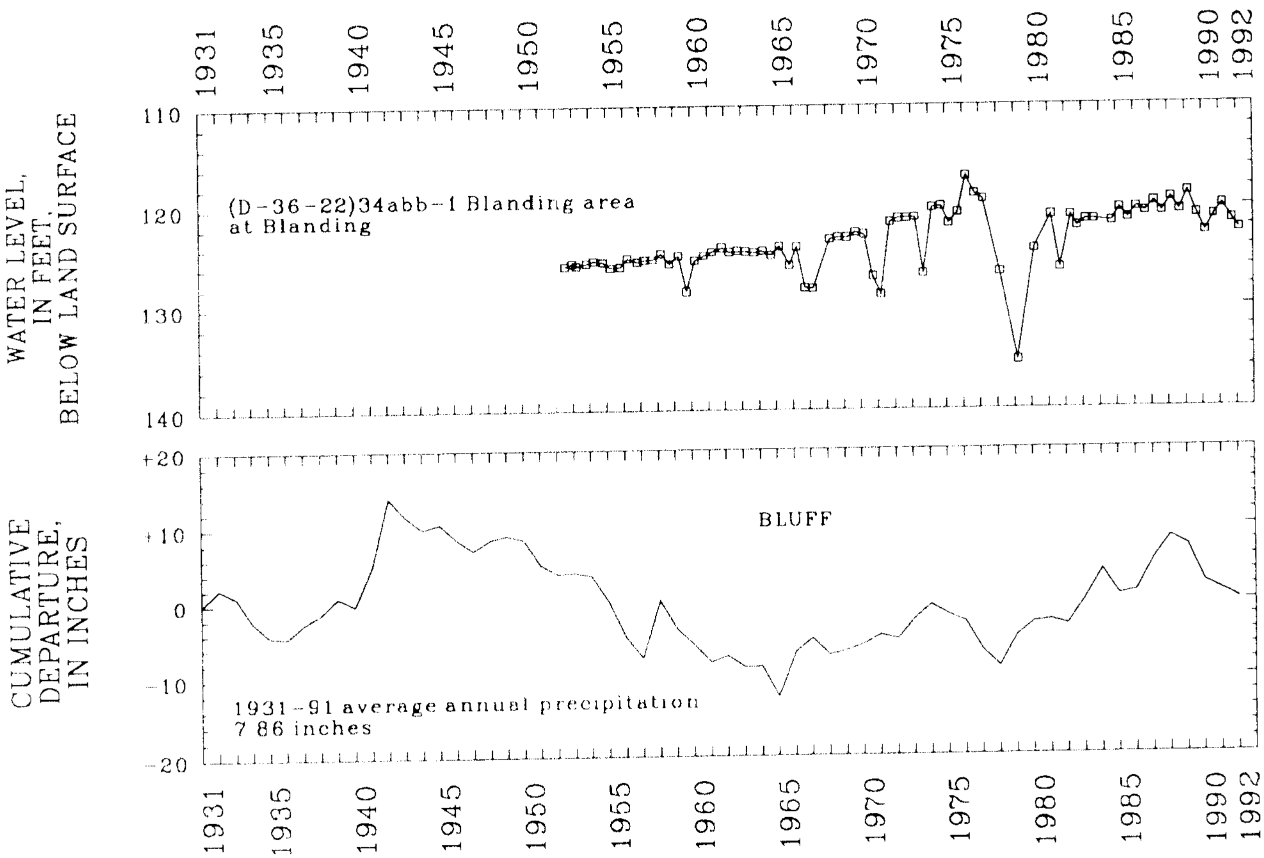

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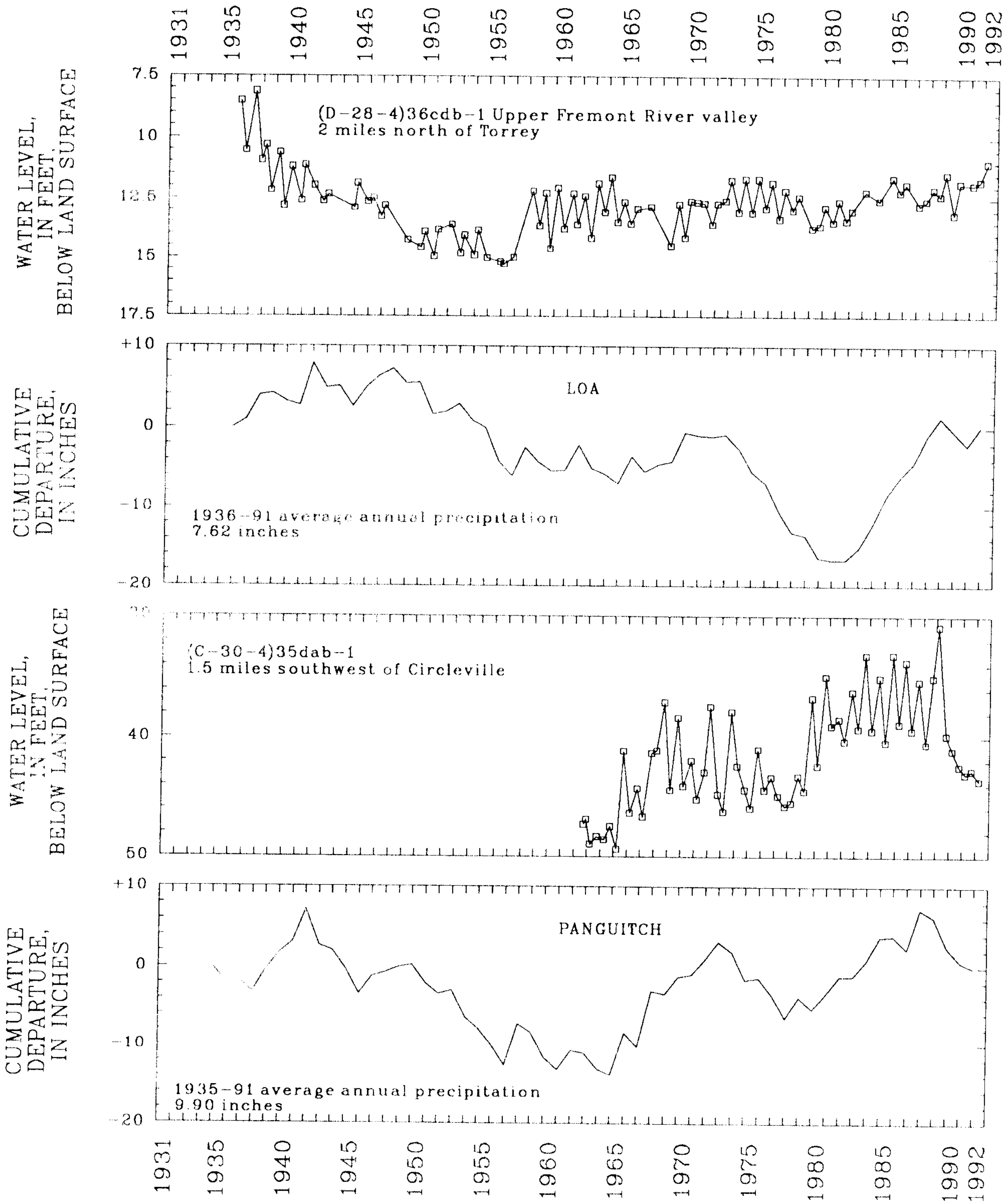

Figure 41.--Continued

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